North Phoenix Wash Vegetation Study

October 1998

Prepared for
City of Phoenix
Parks, Recreation, and Library Department

Prepared by
Arizona State University
College of Architecture and Environmental Design
School of Planning and Landscape Architecture

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Photo credits: Bob Rink (figures 1–5), Joseph Ewan (figure 6), Rebecca Fish Ewan (all other photos)

Executive Summary

Study Purpose and Report Contents

The intent of the *North Phoenix Wash Vegetation Study* was to inventory and map vegetation along Apache Wash and its tributaries, Skunk Creek Wash and its tributaries, and Deadman Wash. The results were then applied to the development of recommendations for the Sonoran Preserve and to suggestions for further research to help ensure the preservation of these wash systems within the City of Phoenix. The study areas span approximately one-quarter mile on both sides of the centerline of each wash and are bounded on the north by the Phoenix city limit and on the south by the Cave Buttes Recreation Area, the Central Arizona Project (CAP) canal, and the western Phoenix city limit. The Apache Wash system includes Desert Lake Wash and Paradise Wash, which are western and eastern tributaries to Apache Wash. The Skunk Creek Wash tributaries are the unnamed system of secondary washes east of Skunk Creek Wash.

The study team included faculty and students from the School of Planning and Landscape Architecture at Arizona State University's (ASU) main campus. In addition, numerous individuals assisted in the development of the report, including an urban wildlife specialist from Arizona Game and Fish Department; a water resource planner from the Maricopa County Flood Control District; landscape architects and managers from the City of Phoenix Parks, Recreation, and Library Department (PRLD); and faculty from ASU West's Life Sciences Department. The participants have strong science, ecology, environmental design, or parks development backgrounds.

This study is part of ongoing research that began with the 1996 study of Cave Creek Wash.[1] This report includes brief site descriptions, discussion of study methods and results, and recommendations relevant to the Phoenix Sonoran Preserve. The report can be used to help inform future planning for the preservation of washes in North Phoenix and as baseline data for analyzing vegetation changes affected by urban development in the North Phoenix area.

Methods

Vegetation Sampling

Vegetation data were collected as follows. Using aerial photographs and preliminary site visits, five general vegetation zones were established and tentatively identified on the aerial photographs. Sampling was done using a stratified random design to assure sampling in all of the different vegetation zones and was spread across the study area to assure a representative sample. Each circular sample quadrat measured 100 square meters. The quadrats were recorded with a Global Positioning System (GPS) to help in relocating the sampling plot in the future. In each quadrat all nonherbaceous perennials (i.e., trees, shrubs, and cacti) were counted and identified by species. Percent cover was estimated for groundcover. Tree and shrub canopies were measured for up to ten plant counts, so percent cover could be estimated. Sampling was conducted in April and May of 1997 and 1998. Vegetation sampling was conducted for 104 quadrats in the Apache Wash study area, 111 quadrats in the Skunk Creek Wash study area, 97 for the Skunk Creek tributaries, and 83 for Deadman Wash for a total of 395 sampling plots along the approximately 30 linear miles of wash. The final determination of vegetation types was based on a combination of the formal analysis, field experience, and aerial photos. Classification follows Turner and Brown (1982) for the naturally occurring vegetation; however, vegetation types that were a result of human impact or damaging influences (e. g., stock tanks or fires) were also grouped. Vegetation types were entered into a Geographic Information System (GIS) database for mapping and analysis purposes. Wildlife data were collected by noting sightings and signs during the vegetation survey. This wildlife information is anecdotal and serves only to illustrate the relationship between animal habitat needs and vegetation types. A comprehensive wildlife inventory was beyond the scope of this study. Another ASU study is underway to analyze wildlife species diversity and density along Cave Creek and Skunk Creek washes.

[1] Ewan, Fish Ewan, et al. 1996. *Cave Creek Wash Preservation Boundary Study.* Herberger Center for Design Excellence.

Preservation and Research Priority Development

This process incorporated ecological information gleaned from field sampling and the expertise of landscape architects, planners, open space managers, and ecologists. During two working meetings, the participants considered preservation recommendations for the Sonoran Preserve boundary with regard to each wash system. The participants examined the general preservation recommendations that were adapted from the *Cave Creek Wash Preservation Boundary Study* to reflect the specific conditions of the four drainage systems under investigation in this study.[2] The group developed recommendations for further research on the proposed preserve lands.

Results

The vegetation was classified into four types based on vegetation composition and landscape physiognomy. A fifth type, damaged areas, was included to describe places where human interference was so severe the vegetation could not be characterized. Vegetation types are similar to those used for the *Cave Creek Wash Preservation Boundary Study,* though sloped terrain is grouped with hillside vegetation rather than wash edges, because the vegetation along these slopes is more consistent with the hillside vegetation sampled in the study areas. The five vegetation types are as follows.

Wash Vegetation

This vegetation type includes the sandy, rocky, open channel and sand bars and is characterized by annuals, big leaf bursage (*Ambrosia ambrosiodes*), desert broom (*Baccharis sarothroides*), and seep willow (*Baccharis salicifolia*). The wash bed is subject to scouring, which inhibits growth of large trees and dense patches of shrubs, and maintains a dynamic vegetation composition in which forbs are dominant.

The vegetation along the wash edge represents the richest areas of upland habitat. Blue palo verde (*Cercidium floridum*) and ironwood (*Olneya tesota*) are characteristic trees that grow along wash edges. Wash edges are areas of higher moisture than surrounding areas and consequently support the highest density and stature of trees.

Creosote Bush-Bursage Flats

This type is typical of Turner and Brown's (1982) creosote bush-bursage series of the Lower Colorado River Valley subdivision dominated by creosote bush (*Larrea tridentata*) and triangle-leaf bursage (*Ambrosia deltoidea*). This vegetation is the most widespread because it can tolerate saline caliche soil and hot arid conditions of the desert flats. Although it is fairly heterogeneous in its undisturbed state, grazing and fires appear to have decreased plant species diversity particularly in portions of the Skunk Creek study area. Within this type are stands of Opuntia species particularly pencil cholla (*Opuntia arbuscula*) and buckthorn cholla (*Opuntia acanthacarpa*).

Hillsides and Slopes

Vegetation characteristic on slopes include foothill palo verde (*Cercidium microphyllum*), triangle-leaf bursage, creosote, teddy bear cholla (*Opuntia bigelovii*), and buckthorn cholla. Saguaro cacti (*Carnegiea gigantea*) occur most frequently on slopes as well. This vegetation type is found on the prominent hillsides within the study areas and along the many less obvious slopes that mark elevation changes within the creosote bush-bursage flats.

Tanks

There are three tanks (Bosco, Purcell, and Tin Can) along Apache Wash, two tanks (Bronco and Skunk Creek) on Skunk Creek Wash, one (Circle) along the tributaries, and three (Aso, Palo Verde, and CF) along Deadman Wash. The tanks are artificial detention areas along natural drainage ways. They support a dense community of mesquite (*Prosopis velutina*). Tin Can Tank is unique in that it is dominated by blue palo verde. Other vegetation includes buckthorn cholla and catclaw acacia (*Acacia greggii*). Bermuda grass (*Cynodon dactylon*) is a common invasive plant. This vegetation type also appears just above the CAP where water pools along the canal bank.

Damaged

A large portion of the Skunk Creek Wash study area has been burned and is now dominated by bursage. Prior to the burn, the land may have supported hillside and creosote bush-bursage vegetation. Currently the shrub cover is 10% of that in other creosote bush-bursage communities and 13% of that on hillsides in the Skunk Creek Wash study area. Other damaged lands are associated with tanks where cattle grazing has developed bare ground or sparse bermuda grass patches.

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[2] The eastern tributaries to Skunk Creek are extensive and were considered as a separate drainage system, bringing the count to four, while those of Apache Wash were included in the analysis of Apache Wash.

Recommendations

Preservation

The recommendations listed below are those adapted from the Cave Creek Wash study. They are noted here because they were considered by the working meeting participants and continue to be guidelines for the development of the preserve.

1. Preserve as large an area as possible.
2. Minimize isolation and fragmentation of habitats.
3. Minimize contact with adjacent developed areas.
4. Preserve as much wash vegetation as possible.
5. Preserve beyond the 100-year flood zone.
6. Prohibit grazing within the preserve.
7. Maintain the integrity of the watersheds.
8. Maintain a diversity of animal habitats and species.
9. Maintain the cliff areas along Skunk Creek Wash.
10. Maintain tanks and surrounding vegetation.
11. Preserve areas representing mosaics of vegetation classification types.[3]

Further Research

During the working meetings, there was considerable discussion on the effects and character of future adjacent development and increased human activity. Knowing the existing ecological integrity of the preserve was also identified as essential for ensuring continued health and maintenance of the desert flora and fauna. The consensus among ecologists is that the bigger the area preserved, the better; this belief was echoed during the meetings. In reviewing the approved preserve boundary, there were no direct criticisms. Rather, it was recommended that the preserve be further studied as an ecological system. The prioritized list below identifies research needed to this end and includes other studies that address human impacts.

1. Continue the vegetation and wildlife inventories to include the remaining land within the preserve.
2. Examine fluvial dynamics of each wash. The Maricopa County Flood Control District has begun to study the Cave Creek and Apache washes; similar studies should be conducted for the other washes within the preserve.
3. Set up long-term monitoring sites to examine edge effect and changes in species composition and diversity within the proposed preserve that result from influences at the preserve edge. This would facilitate the monitoring and managing of the ecological integrity of the preserve and allow for analyzing changes in vegetation and wildlife over time.
4. Conduct soil surveys to inform long-term land management decisions.
5. Examine management plans for urban wild land preserves to help the PRLD as they develop the management plan for the Sonoran Preserve.
6. Study wildlife movement to help inform corridor planning with regard to corridor widths and orientation.
7. Conduct comparative studies for analyzing wash buffer widths.
8. Conduct case studies of other existing preserve lands to consider road crossings with regard to number, widths, and character (e. g., parkway, freeway, commercial strip).
9. Review the process for developing the preserve boundary to continue to build layers of research and data that supports and improves this method of taking an ecological approach to preserve design. A review of existing studies and preserves should be included in this study.

Conclusion

As an extension of the Cave Creek Wash study, this report enlarged the range of vegetation analysis more than four-fold. The results can be used in further preservation planning in the North Phoenix area. Integrating this kind of ecological information into open space planning will help the PRLD carry on and improve upon their legacy of preserve development. For over thirty years the only large land parcels set aside for preservation in the City of Phoenix are the result of the PRLD's proactive leadership and guidance. It is hoped that this study and others like it contribute to developing park lands that preserve the ecological integrity and health of the Sonoran Desert that has become emblematic of Phoenix's quality of life.

[3] A landscape or vegetation mosaic is the composition and spatial organization of components (Forman 1995); in this case the mosaics refer to compositions of the four vegetation types.

North Phoenix Wash Vegetation Study

Introduction

Study Purpose and Report Contents

The intent of the *North Phoenix Wash Vegetation Study* was to inventory and map vegetation along Apache Wash and its tributaries, Skunk Creek Wash and its tributaries, and Deadman Wash. The results were then applied to the development of recommendations for the Sonoran Preserve and suggestions for further research to help ensure the preservation of these wash systems within the City of Phoenix. The study areas span approximately one-quarter mile on both sides of the centerline of each wash and are bounded on the north by the Phoenix city limit and on the south by the Cave Buttes Recreation Area, the Central Arizona Project (CAP) canal, and the western Phoenix city limit (map 1). The Apache Wash system includes Desert Lake Wash and Paradise Wash, which are western and eastern tributaries to Apache Wash (figure 1). The Skunk Creek Wash tributaries are the unnamed system of secondary washes east of Skunk Creek Wash (figures 2 and 3). All of the wash areas studied are east of Interstate 17 except for the areas studied associated with Deadman Wash, which is west of the interstate (figure 4).

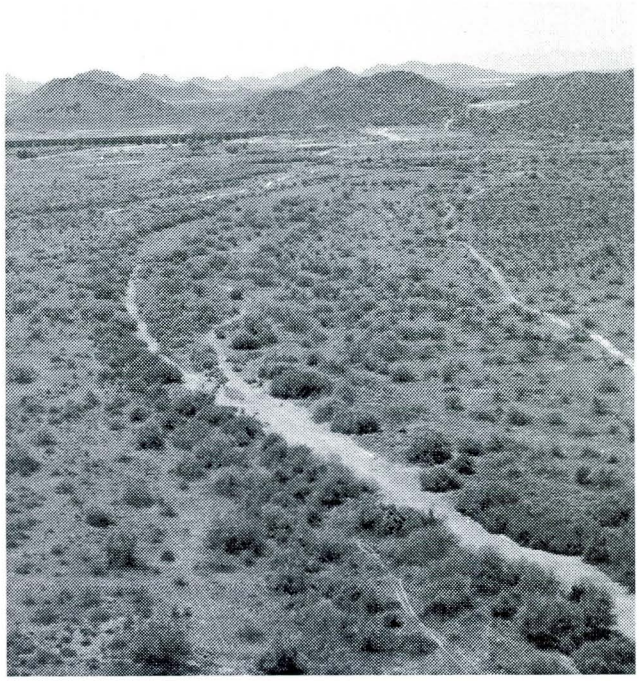


Figure 1—Aerial view of Apache Wash

Charles H. Lowe (1977) cites three reasons why vegetation is the basis for ecological classification of terrestrial biotic communities: (1) plants are one of the essential features of the landscape, (2) they remain in one location, and (3) they express the effective environment to the observer. Lowe points out that perennial plants in particular are the "ever-present, sensitive, readily observed, measurable and mappable indicators" (1977, 5) of climate, soil, topography, and biotic factors. Recognizing this, field work focused on mapping and classifying vegetation. Wildlife and other factors relevant to the ecological condition of the washes were noted during field visits, but because plants have been found to successfully indicate biotic communities, vegetation was the primary focus for the data sampling.

The study team included faculty and students from the School of Planning and Landscape Architecture at Arizona State University's (ASU) main campus. In addition, numerous individuals assisted in the development of the report, including an urban wildlife specialist from Arizona Game and Fish Department; landscape architects and managers from the City of Phoenix Parks, Recreation, and Library Department (PRLD); and faculty from ASU West's Life Sciences Department. The participants have strong science, ecology, environmental design, or parks development backgrounds.

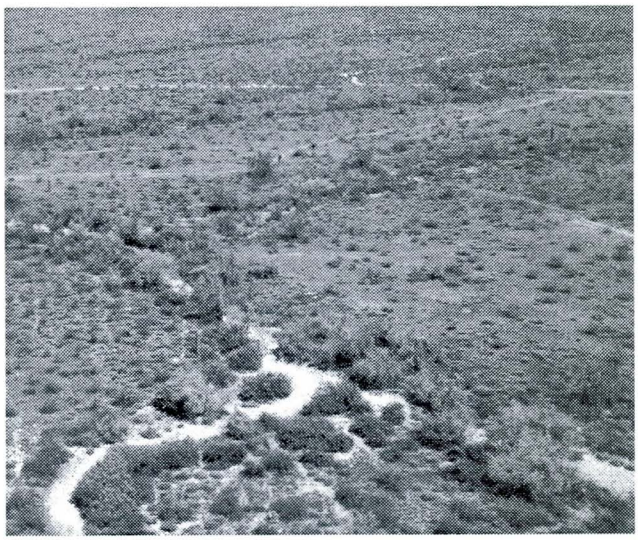


Figure 2—Aerial view of Skunk Creek Wash tributaries

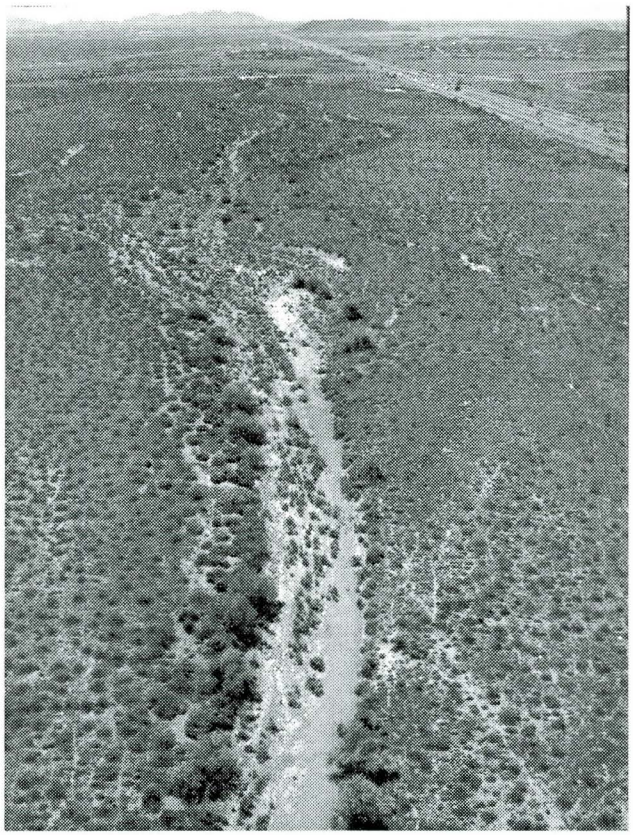


Figure 3—Aerial view of Skunk Creek Wash

This study is part of ongoing research in the North Phoenix area that began with the 1996 study of Cave Creek Wash (figure 5). Ecological inventories such as these are among the recommendations that emerged from the *Findings of the North Sonoran Land Use Charrette* (McCarthy et al. 1995) and the *Desert Preserve Preliminary Plan* (COP 1994). The report includes brief site descriptions, discussion of study methods and results, and recommendations for the preserve and concludes with recommendations regarding further research and planning priorities. The report can be used to help inform future planning for the preservation of washes that are included in the Sonoran Preserve System and as baseline data for analyzing vegetation changes as urban development progresses in the North Phoenix area.

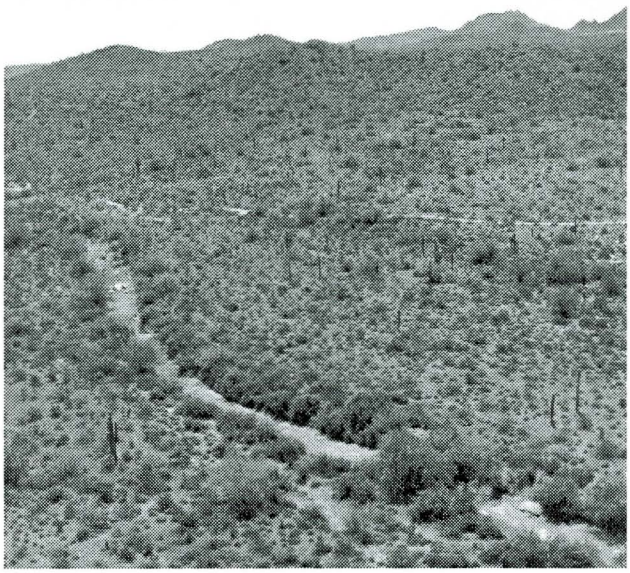
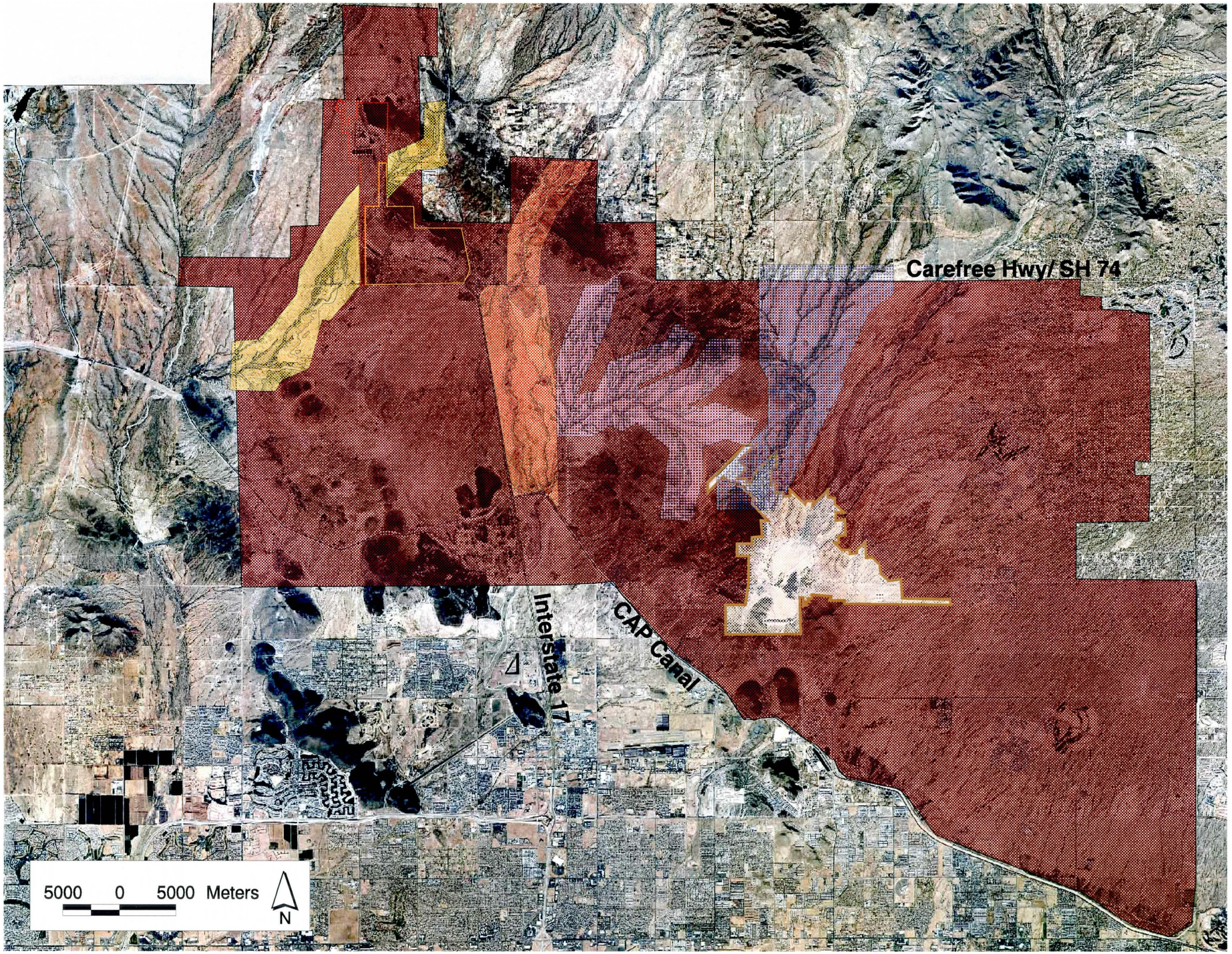


Figure 4—Aerial view of Deadman Wash

Figure 5—Cliffs along Cave Creek Wash

North Phoenix Wash Study



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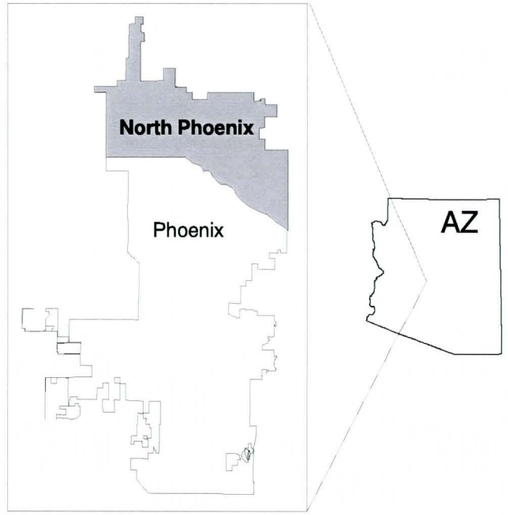
- Apache Wash Study Area
- Deadman Wash Study Area
- Skunk Creek Wash Study Area
- Skunk Creek Tributaries Study Area

- Federal Lands
- AZ Game & Fish
- Cave Buttes Recreation Area
- Wash Centerlines
- North Phoenix

Location Map



ASU Arizona State University
School of Planning and Landscape Architecture

City of Phoenix
Parks, Recreation and Library Department

Study Area Description

The study area is located in the transition between Lower Colorado River Valley and the Arizona Upland subdivisions of the Sonoran Desert scrub biome (Turner and Brown 1982). The Lower Colorado River Valley, or microphyllous desert, is the largest and most arid subdivision of the Sonoran Desert. Low annual precipitation and high temperatures support sparse vegetation. The average annual precipitation reported for the city of Phoenix is 10.27 inches. Characteristic species include blue palo verde (*Cercidium floridum*), creosote bush (*Larrea tridentata*), and triangle-leaf bursage (*Ambrosia deltoidea*). The Arizona Upland subdivision is the most lush and watered desert scrub in North America. The nearby community of Cave Creek, northeast of the study area, receives an average annual precipitation of 16.93 inches (Turner and Brown 1982). The result of this increase in moisture is an increase in both vegetation diversity and stature that enriches the area from both an aesthetic and wildlife habitat perspective. Characteristic species are ironwood (*Olneya testota*), foothill palo verde (*Cercidium microphyllum*), and saguaro (*Carnegiea gigantea*). The physiography is typical of the basin and range province, with alluvial valleys bounded by elongated mountains (figure 6).

Although the washes are typically dry throughout most of the year, they all experience substantial peak flows during storms. For example Apache Wash experiences flows ranging from 5,463 to 17,136 cfs and Skunk Creek Wash carries 23,300 cfs during 100-year events (FEMA 1995 and 1997). Since their watershed is almost entirely within the study area, peak flows for the tributaries are quite variable, ranging from 59 to 11,478 cfs (HKBW Engineers 1992).

Wildlife in the area includes birds such as red-tailed hawk, Gila woodpecker, great-horned owl, and cactus wren; small mammals such as black-tailed jackrabbit, desert cottontail, white-throated wood rat, and kangaroo rat; amphibians and reptiles such as the greater earless lizard, western diamondback rattlesnake, red-spotted toad, and Colorado river toad; and a limited number of large mammals such as desert mule deer, coyote, and bobcat.[4]

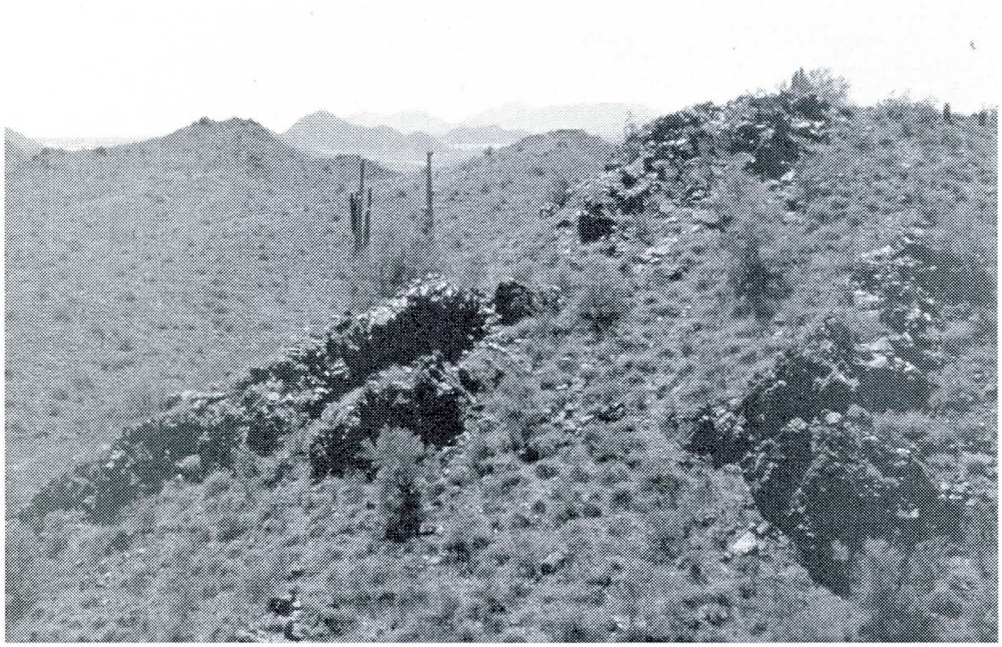


Figure 6–Basin and range landscape with Union Hills in the foreground

[4] The wildlife noted were either observed during field visits for this study or are from the preliminary list of Dr. William Miller's current wildlife study along Skunk Creek Wash.

Methods

The study combines scientific field research with the art of landscape planning, so the methods description is divided into two sections: the first outlines the vegetation sampling and analysis methods, the second describes the boundary refinement and research priority development methods. The following list outlines the process in its entirety:

- Field study: Ecologists and landscape architects conducted vegetation sampling in the field, noted presence of animal species, and developed general recommendations regarding the preservation boundary.
- Working meeting: Participants reviewed the field results and considered preserve boundary refinements and further studies needed to help in managing the wash vegetation.
- Map synthesis: Codirectors synthesized results and recommendations into a draft report.
- Evaluation: Study participants evaluated and revised the draft report to produce this document.

Vegetation Sampling and Analysis

Vegetation data were collected as follows. Using aerial photographs and preliminary site visits, five general vegetation zones were established and tentatively identified on the aerial photographs. Sampling was done using a stratified random design to assure sampling in all of the different vegetation zones and was spread across the study area to assure a representative sample. Each circular sample quadrat measured 100 square meters. The quadrats were recorded with a Global Positioning System (GPS) to help in relocating the sampling plot in the future. In each quadrat all nonherbaceous perennials (i.e. trees, shrubs and cacti) were counted and identified by species. Percent cover was estimated for groundcover. Tree and shrub canopies were measured for up to ten plant counts, so percent cover could be estimated. Sampling was conducted in April and May of 1997 and 1998. Vegetation sampling was conducted for 104 quadrats in the Apache Wash study area, 111 quadrats in the Skunk Creek Wash study area, 97 for the Skunk Creek tributaries, and 83 for Deadman Wash for a total of 395 sampling plots along the approximately 30 linear miles of wash. The final determination of vegetation types was based on a combination of the formal analysis, field experience, and aerial photos. Classification follows Turner and Brown (1982) for the naturally occurring vegetation; however, vegetation types that were a result of human impact or damaging influences (e. g., stock tanks or fires) were also grouped. Vegetation types were entered into a Geographic Information System (GIS) database for mapping and analysis purposes. Animal data were collected by noting sightings and signs during the vegetation survey. This wildlife information is anecdotal and serves only to illustrate the relationship between animal habitat needs and vegetation types. A comprehensive wildlife inventory was beyond the scope of this study. Another ASU study is underway to analyze wildlife species diversity and density along Cave Creek and Skunk Creek washes.

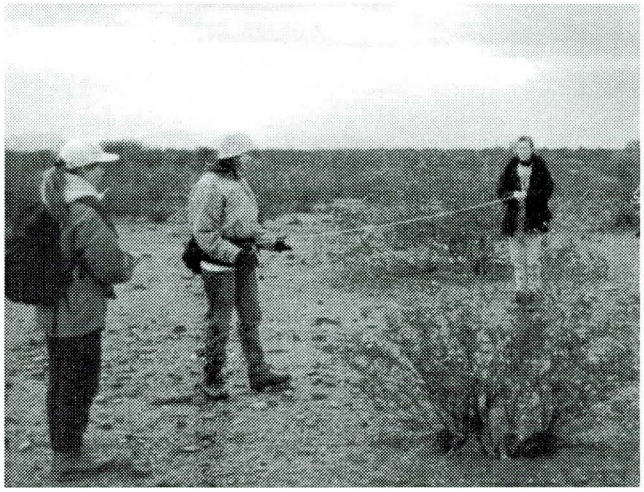


Figure 7–Vegetation sampling along Apache Wash

Preservation and Research Priority Development

This process incorporated ecological information gleaned from field sampling and the expertise of landscape architects, planners, open space managers, and ecologists. During two working meetings the participants considered refinements to the Sonoran Preserve boundary with regard to each wash system. Using methods common to charrettes and focus groups, the group developed recommendations for further research on the proposed preserve lands. The participants also examined the general preservation recommendations that were developed for the 1996 Cave Creek Wash study and revised them to reflect the specific conditions of the four wash systems under investigation in this study.

Results

Results

The field results are presented below. Outcomes of the working meeting are presented in the recommendation section. The vegetation was classified into four types that represent subsets of the Lower Sonoran and Arizona Uplands biotic communities; damaged areas were considered a fifth type. Type differentiation was based on dominant vegetation and physiogomy. The classification provides a landscape division with several practical benefits to land-use planning: (1) it is recognizable in the field and through aerial photographs; (2) it provides a descriptive level of detail appropriate and useful for making land-use decisions at the scale to be used by the PRLD during the preserve planning process; and (3) it contains enough specificity to have site-specific discussions regarding wildlife habitat values (food, water, territory, and shelter). It should be noted, however, that while the vegetation types are recognizable, they are not completely distinct. No hard line exists between each type, rather the vegetation compositions transition from one type to another within an ecotone.[5] This is typical for most vegetation classification systems (Lowe and Brown 1982). The five-type classification system nonetheless offers a description of the vegetation within the study area that accurately depicts the vegetation compositions and provides a useful tool for land-use planning. In presenting the vegetation types, trees, shrubs, and cacti species are mentioned (see Appendix A for a complete list of identified plant species). Maps 2 through 5 show the composition of the four vegetation types and damaged areas for each wash system and areas that have experienced enough damage to make vegetation classification impossible. Damaged sites have relatively sparse vegetation cover. In addition to the vegetation divisions, wildlife observations were noted during all field visits (see Appendix A for a list of animal species). Examinations of the five vegetation types follow.

Wash Vegetation

This vegetation type includes the sandy, rocky, open channel and sand bars and is characterized by annuals, big-leaf bursage (*Ambrosia ambrosiodes*), desert broom (*Baccharis sarothroides*), and seep willow (*Baccharis salicifolia*). The wash bed is subject to scouring. This scouring inhibits growth of large trees and dense patches of shrubs and maintains a dynamic vegetation composition in which forbs are dominant (figure 9).

Figure 9—Wash vegetation along Skunk Creek Wash

Figure 8–Summary of Vegetation Sampling

	All	Wash	Cbb	Hill	Tank	Damaged
Quadrats	395	162	158	50	11	14
Plants/Quad	25.5	24.0	21.2	50.7	17.1	7.6
Apache	2,411	761	1,103	507	40	0
Tributaries	3,030	1,067	962	978	12	11
Skunk Creek	2,388	1,023	659	574	99	52
Deadman	2,216	1,035	622	478	37	44
Totals	**10,064**	**3,886**	**3,346**	**2,537**	**188**	**107**

[5] An ecotone is a "habitat created by abutment of very different habitats or a transition area between them" (Shafer 1990, 152). In this case the ecotone is the transition area between any combination of the four vegetation types.

Figure 10–Wash vegetation along Apache Wash

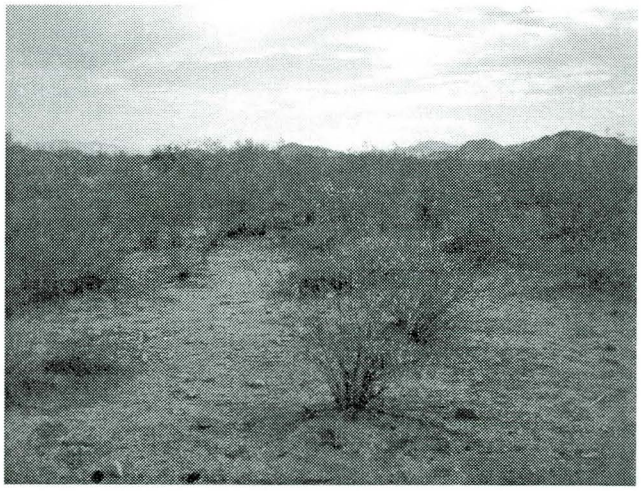


Figure 11—Creosote bush-bursage flat vegetation along Skunk Creek Wash

Figure 12—Creosote bush-bursage flat vegetation along Apache Wash

The vegetation along the wash edge represents the richest areas of upland habitat. Blue palo verde (*Cercidium floridum*) and ironwood (*Olneya tesota*) are characteristic trees that grow along wash edges. Stream channels are areas of higher moisture than surrounding areas and consequently support higher density and stature of trees and shrubs. The densest vegetation is often in the smaller channels that are not subject to large amounts of scouring (figure 10).

Creosote Bush-Bursage Flats

This type is typical of the creosote bush-bursage series of the Lower Colorado River Valley subdivision dominated by creosote bush (*Larrea tridentata*) and triangle-leaf bursage (*Ambrosia deltoidea*) (Turner and Brown 1982). This vegetation is the most widespread because it can tolerate saline caliche soil and hot arid conditions of the desert flats. Although it is fairly heterogeneous in its undisturbed state, grazing and fires appear to have decreased plant species diversity particularly in the Skunk Creek study area (figure 11). Within this type are stands of Opuntia species particularly pencil cholla (*Opuntia arbuscula*) and buckthorn cholla (*O. acanthacarpa*). The predominant stands are interspersed throughout the northwest section of the Apache Wash study area and throughout the upper reaches of the Skunk Creek tributaries, though they also occur in the upper reach of the Skunk Creek Wash study area and within the Deadman Wash study area (figure 12).

Hillsides and Slopes

Vegetation characteristic on slopes include foothill palo verde (*Cercidium microphyllum*), triangle-leaf bursage, creosote, teddy bear cholla (*Opuntia bigelovii*), and buckthorn cholla. Saguaro cacti (*Carnegiea gigantea*) occur most frequently on slopes as well. This vegetation type is found on the prominent hillsides within the study areas and along the many less obvious slopes that mark elevation changes within the creosote bush-bursage flats (figure 13).

Tanks

There are three tanks (Bosco, Purcell, and Tin Can) along Apache Wash, two tanks (Bronco and Skunk Creek) on Skunk Creek Wash, one (Circle) along the tributaries, and three (Aso, Palo Verde, and CF) along Deadman Wash. The tanks are

artificial detention areas along natural drainage ways designed to water stock animals (figure 14). They support a dense community of mesquite (*Prosopis velutina*). Tin Can Tank is unique in that it is dominated by blue palo verde (figure 15). Other vegetation includes buckthorn cholla and catclaw acacia (*Acacia greggii*). Bermuda grass (*Cynodon dactylon*) is a common invasive species. This vegetation type also appears just above the CAP where water is detained by the canal bank.

Damaged

A large portion of the Skunk Creek Wash study area has been burned and is now dominated by bursage. Prior to the burn, the land may have supported hillside and creosote bush-bursage vegetation. Currently in the Skunk Creek Wash study area, the damaged site has a shrub density that is 10% of that in other creosote bush-bursage communities and 13% of that on hillsides. Other damaged lands are associated with tanks where cattle grazing has developed bare ground or sparse bermuda grass patches (figure 16).

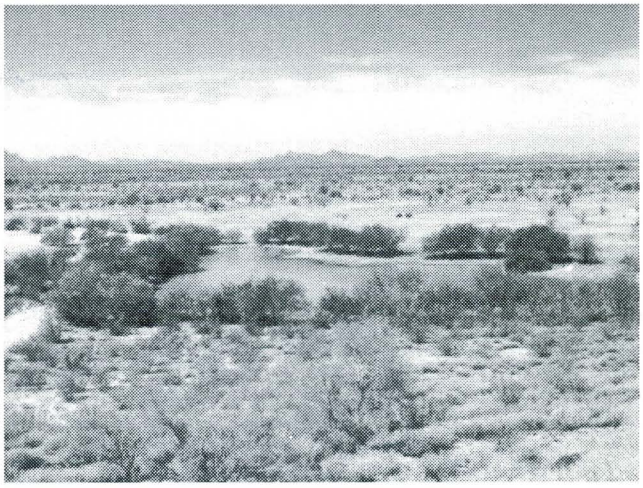


Figure 14—Tank vegetation at Bronco Tank

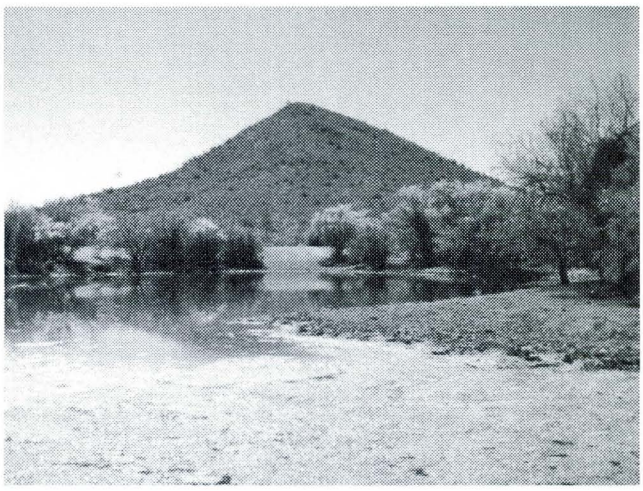


Figure 15—Tank vegetation at Tin Can Tank

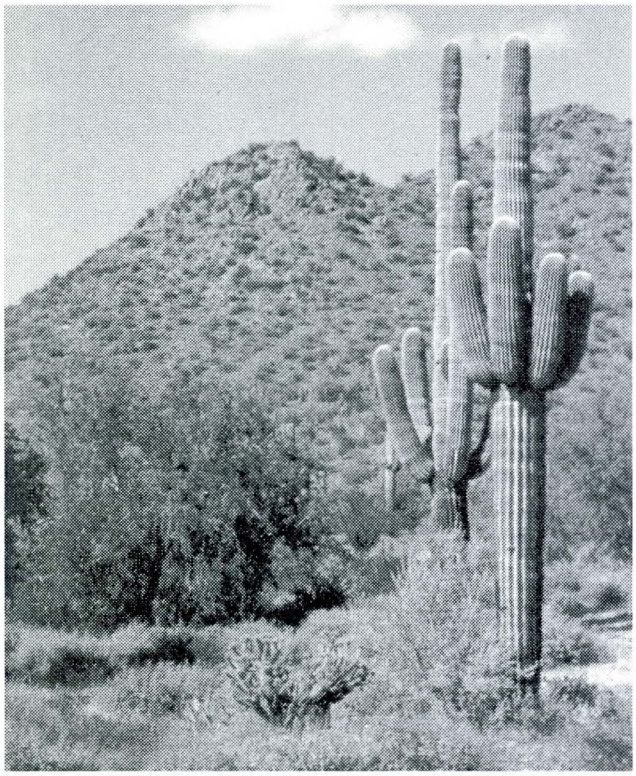


Figure 13–Hillside vegetation adjacent to Skunk Creek tributaries

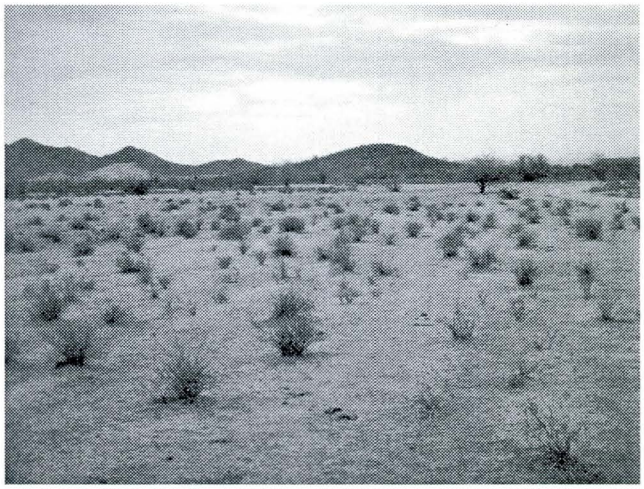


Figure 16–Damaged area along Skunk Creek

Apache Wash Study Area

Apache Wash

Plant counts by species (percent)

Scientific Name	Common Name	Code	All	Wash	Cbb	Hill	Tank
Acacia greggii	Cat-claw acacia	ACGR	3.1	9.5	0.1	0	2.5
Ambrosia ambrosioides	Big-leaf bursage	AMAM	6.1	19.3	0	0	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	54.0	32.2	64.3	68.8	0
Baccharis sarothroides	Desert broom	BASA	0.5	1.4	0	0	0
Cassia covesii	Desert senna	CACO	0.2	0	0.4	0	0
Carnegiea gigantea	Saguaro	CAGI	0.2	0.1	0.1	0.6	0
Cercidium floridum	Blue palo verde	CEFL	0.6	1.3	0.1	0	7.5
Cercidium microphyllum	Foothill palo verde	CEMI	0.7	1.3	0.5	0	5.0
Celtis pallida	Desert hackberry	CEPA	0.2	0.4	0.1	0	0
Clematis drummondii	Virgin's bower	CLDR	0.3	0.9	0	0	0
Echincereus engelmannii	Hedgehog cactus	ECEN	0.4	0.1	0.3	1.0	0
Ferocactus acanthodes	Barrel cactus	FEAC	0.6	0.1	0.7	1.0	0
Fouquieria splendens	Ocotillo	FOSP	*	0	0.1	0	0
Krameria grayii	White ratany	KRGR	0.7	0	0.6	2.2	0
Larrea tridentata	Creosote	LATR	16.8	17.2	20.3	9.3	10.0
Lycium sp.	Wolfberry	LYCI	3.1	6.0	1.6	2.0	0
Olneya tesota	Ironwood	OLTE	0.2	0.5	0	0.2	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	3.6	1.3	5.3	3.6	0
Opuntia arbuscula	Pencil cholla	OPAR	0.2	0.3	0.3	0	2.5
Opuntia bigelovii	Teddy bear cholla	OPBI	1.4	0.1	0.3	5.9	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	1.4	0.4	2.6	0.4	0
Opuntia phaeacantha	Prickly pear cactus	OPPH	0.2	0.3	0	0.4	0
Prosopis velutina	Velvet mesquite	PRVE	4.2	4.2	1.5	4.7	72.5
Ziziphus obtusifolia	Graythorn	ZIOB	1.4	2.9	1.0	0	0

* present at less than 0.1%

Apache Wash

(104 Quadrats Total)

	Wash	Cbb	Hill	Tank
No. Quads	32	58	11	3
Spp/quad	5.3	2.6	4.7	3.7
Percent cover by plant type				
Trees	45.0	3.8	7.3	128.4
Shrubs	37.3	21.6	30.1	3.9
Cacti	0.5	2.4	4.5	0

Apache Wash

Percent herbaceous cover**

	Wash	Cbb	Hill	Tank
0-5%	34	34	55	0
5-15%	28	33	18	0
15-25%	13	21	0	33
25-50%	13	10	18	33
50-75%	0	2	0	33
75-90%	3	0	0	0
90-100%	0	0	0	0

Apache Wash

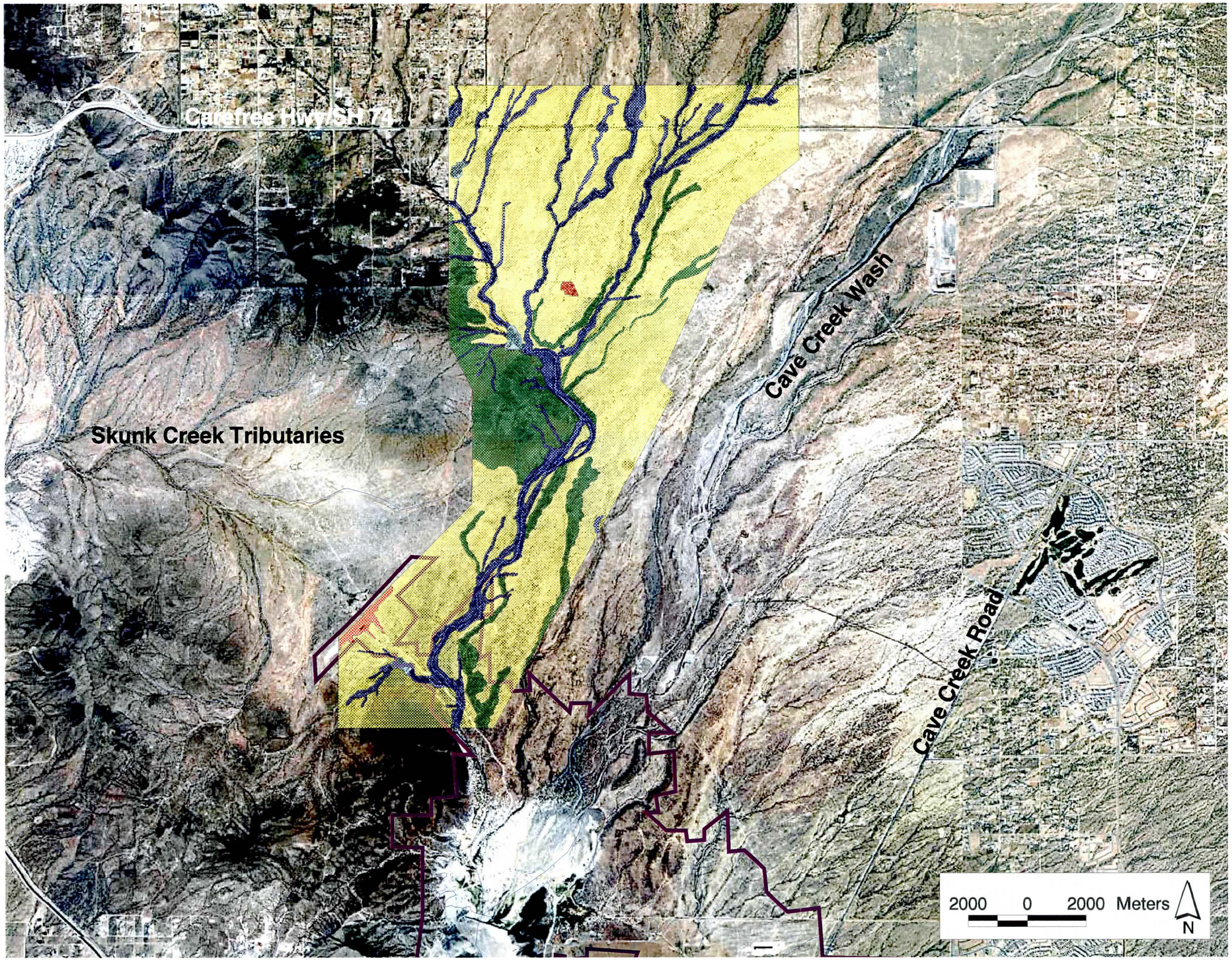
Percent Cover by Species

Scientific Name	Common Name	Code	Wash	Cbb	Hill	Tank
Acacia greggii	Cat-claw acacia	ACGR	9.5	0	0	20.0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	3.8	0	0	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	5.2	7.8	17.2	0
Baccharis sarothroides	Desert broom	BASA	1.2	0	0	0
Cassia covesii	Desert senna	CACO	0	*	0	0
Carnegiea gigantea	Saguaro	CAGI	*	*	0.1	0
Cercidium floridum	Blue palo verde	CEFL	9.5	0.2	0	3.3
Cercidium microphyllum	Foothill palo verde	CEMI	8.7	0.9	0	4.3
Celtis pallida	Desert hackberry	CEPA	0.2	0.1	0	0
Clematis drummondii	Virgin's bower	CLDR	1.0	0	0	0
Echincereus engelmannii	Hedgehog cactus	ECEN	*	*	0.2	0
Ferocactus acanthodes	Barrel cactus	FEAC	*	*	0.1	0
Fouquieria splendens	Ocotillo	FOSP	0	0.1	0	0
Krameria grayii	White ratany	KRGR	0	0.1	1.0	0
Larrea tridentata	Creosote	LATR	20.6	12.9	10.4	3.9
Lycium sp.	Wolfberry	LYCI	4.4	1.0	2.1	0
Olneya tesota	Ironwood	OLTE	0.2	0	0.2	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	0.1	1.7	2.2	0
Opuntia arbuscula	Pencil cholla	OPAR	*	*	0	*
Opuntia bigelovii	Teddy bear cholla	OPBI	*	*	1.4	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	0.3	0.5	0.3	0
Opuntia phaeacantha	Prickly pear cactus	OPPH	0.1	0	0.4	0
Prosopis velutina	Velvet mesquite	PRVE	16.8	1.9	6.4	100.7
Ziziphus obtusifolia	Graythorn	ZIOB	1.1	0.4	0	0

* present at less than 0.1%

**Apache Wash and the lower reach of Skunk Creek Wash were sampled in a dry year; while the remaining areas were sampled during the El Niño wet year. This accounts for the differ ences in percent herbaceous cover.

Apache Wash

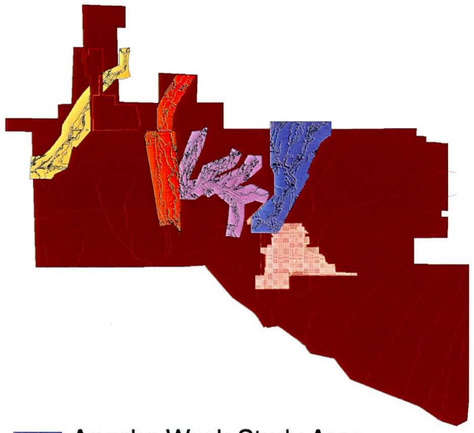


1998

Vegetation Types
- Wash
- Creosote Bush-Bursage Flats
- Hillsides and Slopes
- Tanks
- Damaged

- Federal Lands
- AZ Game & Fish
- Wash Centerlines

Location Map



- Apache Wash Study Area
- Deadman Wash Study Area
- Skunk Creek Wash Study Area
- Skunk Creek Tributaries Study Area

- Federal Lands
- AZ Game & Fish
- Cave Buttes Recreation Area
- Wash Centerlines
- North Phoenix

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Skunk Creek Tributaries Study Area

Skunk Creek Tributaries

Plant counts by species (percent)

Scientific Name	Common Name	Code	All	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	0.9	2.1	0.1	0	25	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	2.0	5.6	0.0	0	0	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	64.0	50.3	68.4	75.2	0	72.7
Baccharis sarothroides	Desert broom	BASA	0.1	0.2	0.0	0	0	0
Bebbia juncea	Sweetbush	BEJU	*	0.1	0.0	0	0	0
Carnegiea gigantea	Saguaro	CAGI	0.3	0.4	0.3	0.1	0	0
Cercidium floridum	Blue palo verde	CEFL	0.1	0.4	0.0	0	0	0
Cercidium microphyllum	Foothill palo verde	CEMI	1.4	3.6	0.0	0.1	16.7	0
Celtis pallida	Desert hackberry	CEPA	1.0	2.5	0.0	0	16.7	0
Echincereus engelmannii	Hedgehog cactus	ECEN	0.4	0.3	0.6	0.3	0	0
Ephedra trifurca	Mormon tea	EPTR	0.1	0.1	0.0	0.1	0	0
Encelia farinosa	Brittlebush	ENFA	4.3	6.3	0.6	5.9	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	0.6	0.2	0.3	1.4	0	0
Fouquieria splendens	Ocotillo	FOSP	0.1	0	0.1	0.2	0	0
Hymenoclea salsola	Burro bush	HYSA	0.1	0.2	0	0	0	0
Krameria grayi	White ratany	KRGR	4.3	5.2	2.1	5.5	8.3	0
Larrea tridentata	Creosote	LATR	9.4	11.2	11.5	5.1	8.3	27.3
Lycium sp.	Wolfberry	LYCI	1.5	4.0	0.1	0	0	0
Mamillaria microcarpa	Fishhook pincushion	MAMI	0.1	0	0	0.2	0	0
Olneya tesota	Ironwood	OLTE	0.2	0.7	0	0	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	4.2	3.2	5.2	4.4	0	0
Opuntia arbuscula	Pencil cholla	OPAR	*	0.1	0	0	0	0
Opuntia bigelovii	Teddy bear cholla	OPBI	3.5	0	9.6	1.3	0	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	0.5	1.0	0.4	0.1	0	0
Prosopis velutina	Velvet mesquite	PRVE	1.1	2.3	0.6	0	25	0
Simmondsia chinensis	Jojoba	SICH	0.1	0.2	0	0	0	0

* Present at less than 0.1%

Skunk Creek Tributaries

(97 Quadrats Total)

	Wash	Cbb	Hill	Tank	Damaged
No. Quads	45.0	33.0	17.0	1.0	1.0
Spp/quad	5.2	3.1	5.0	6.0	2.0
Percent cover by plant group					
Trees	30.6	1.4	0.4	106.9	0
Shrubs	29.8	20.2	27.8	14.8	5.8
Cacti	1.4	3.5	2.1	0	0
Total	61.9	25.1	30.3	121.7	5.8

Skunk Creek Tributaries

Percent herbaceous cover**

	Wash	Cbb	Hill	Tank	Damaged
0-5%	0	0	0	0	0
5-15%	11	0	0	0	50
15-25%	9	9	0	33	50
25-50%	28	31	29	67	0
50-75%	20	34	57	0	0
75-90%	26	22	14	0	0
90-100%	2	0	0	0	0

Skunk Creek Tributaries

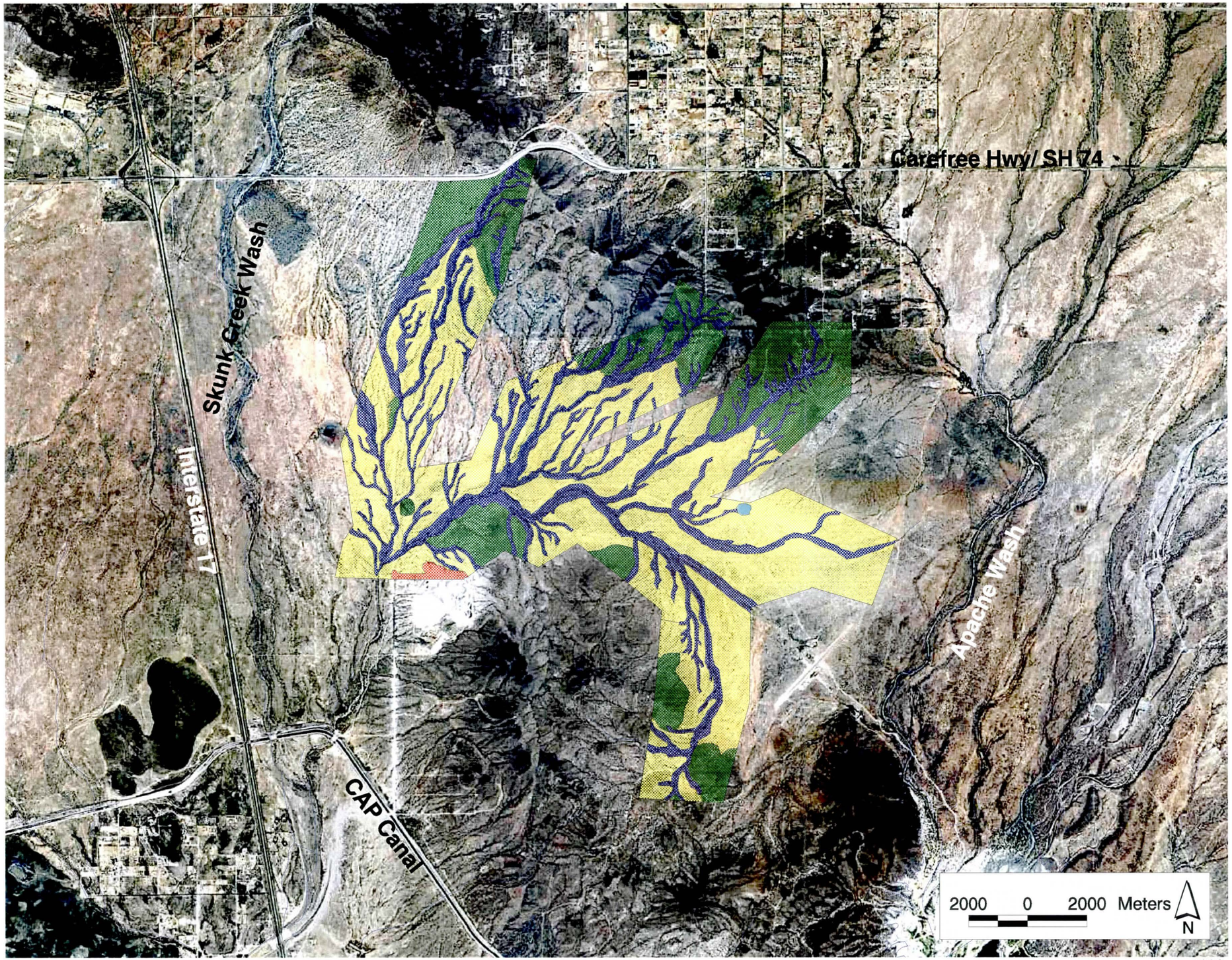
Percent Cover by Species

Scientific Name	Common Name	Code	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	2.1	0.3	0	7.2	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	2.3	0	0	0	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	6.8	9.7	16.1	0	1.6
Baccharis sarothroides	Desert broom	BASA	*	0	0	0	0
Bebbia juncea	sweetbush	BEJU	*	0	0	0	0
Carnegiea gigantea	Saguaro	CAGI	*	0.1	*	0	0
Cercidium floridum	Blue palo verde	CEFL	2.2	0	0	0	0
Cercidium microphyllum	Foothill palo verde	CEMI	9.4	0	0.4	88.4	0
Celtis pallida	Desert hackberry	CEPA	3.4	0	0	4.8	0
Echincereus engelmannii	Hedgehog cactus	ECEN	*	*	*	0	0
Ephedra trifurca	Mormon tea	EPTR	*	0	*	0	0
Encelia farinosa	Brittlebush	ENFA	1.4	0.2	3.5	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	0	*	0.1	0	0
Fouquieria splendens	Ocotillo	FOSP	0	0.1	0.1	0	0
Hymenoclea salsola	Burro bush	HYSA	*	0	0	0	0
Krameria grayi	White ratany	KRGR	1.2	0.5	1.5	3.1	0
Larrea tridentata	Creosote	LATR	12.8	9.8	6.6	9.6	4.2
Lycium sp.	Wolfberry	LYCI	4.2	0.1	0	0	0
Mamillaria microcarpa	Fishhook pincushion	MAMI	0	0	*	0	0
Olneya tesota	Ironwood	OLTE	6.6	0	0	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	0.9	2.2	1.6	0	0
Opuntia arbuscula	Pencil cholla	OPAR	*	0	0	0	0
Opuntia bigelovii	Teddy bear cholla	OPBI	0	0.7	0.2	0	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	0.5	0.5	*	0	0
Prosopis velutina	Velvet mesquite	PRVE	7.4	1.1	0	6.5	0
Simmondsia chinensis	Jojoba	SICH	0.1	0	0	0	0

* Present at less than 0.1%

**Apache Wash and the lower reach of Skunk Creek Wash were sampled in a dry year; while the remaining areas were sampled during the El Niño wet year. This accounts for the differ ences in percent herbaceous cover.

Skunk Creek Tributaries



1998

Vegetation Types
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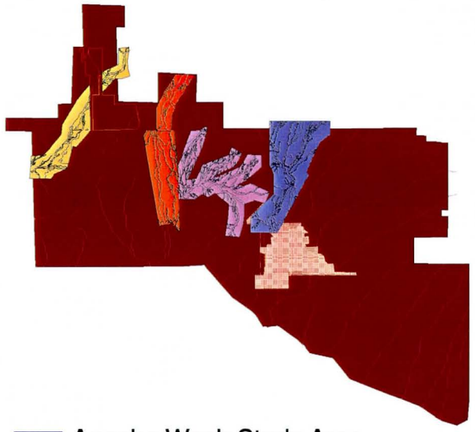
Location Map



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Parks, Recreation and Library Department

Skunk Creek Wash Study Area

Skunk Creek Wash

Plant count by species (percent)

Scientific Name	Common Name	Species	All	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	1.0	1.6	0.2	0	7.1	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	4.0	6.8	0.5	0	22.2	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	66.8	48.5	88.1	78.0	47.5	76.9
Baccharis sarothroides	Desert broom	BASA	0.5	0.5	0	0	6.1	0
Bebbia juncea	Sweetbush	BEJU	1.3	3.0	0	0	0	0
Carnegiea gigantea	Saguaro	CAGI	0.1	0.1	0.3	0	0	0
Cercidium floridum	Blue palo verde	CEFL	0.3	0.6	0	0	0	0
Cercidium microphyllum	Foothill palo verde	CEMI	1.3	2.3	0.2	1.0	0	0
Celtis pallida	Desert hackberry	CEPA	*	0.1	0	0	0	0
Echincereus engelmannii	Hedgehog cactus	ECEN	0.6	0.4	0.3	1.6	0	0
Encelia farinosa	Brittlebush	ENFA	1.9	0.1	0.5	7.1	0	0
Ephedra trifurca	Mormon tea	EPTR	0.1	0	0	0.3	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	0.1	0	0.2	0.3	0	0
Hymenoclea salsola	Burro bush	HYSA	5.6	12.6	0	0	4.0	0
Larrea tridentata	Creosote	LATR	12.9	15.2	16.6	5.4	12.1	9.6
Lycium sp.	Wolfberry	LYCI	1.8	3.3	0.5	0.7	0	1.9
Olneya tesota	Ironwood	OLTE	0.1	0.1	0.2	0.2	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	3.0	1.6	3.9	4.7	1.0	3.8
Opuntia leptocaulis	Desert Christmas cactus	OPLE	0.8	0.4	1.9	0.2	0	5.8
Opuntia phaeacantha	Prickly pear cactus	OPPH	*	0	0	0.2	0	0
Prosopis velutina	Velvet mesquite	PRVE	1.9	1.9	3.9	0.2	0	1.9
Ziziphus obtusifolia	Graythorn	ZIOB	0.4	1.0	0	0	0	0

* present at less than .1%

Skunk Creek Wash

(111 Quadrats Total)

	Wash	Cbb	Hill	Tank	Damaged
No. Quads	46	43	11	3	8
Spp/quad	4.1	2.7	4.5	4.7	1.8
Percent cover by plant group					
Trees	15.2	4.8	8.6	5.8	1.8
Shrubs	25.4	14.0	40.3	32.2	4.2
Cacti	0.6	2.3	2.9	0.1	2.2
Total	41.3	21.1	51.9	38.1	8.2

Skunk Creek Wash

Percent herbaceous cover**

	Wash	Cbb	Hill	Tank	Damaged
0-5%	28	32	9	25	29
5-15%	13	23	9	50	43
15-25%	17	16	9	0	0
25-50%	19	2	18	0	14
50-75%	4	2	0	0	0
75-90%	6	5	45	0	14
90-100%	6	14	9	25	0

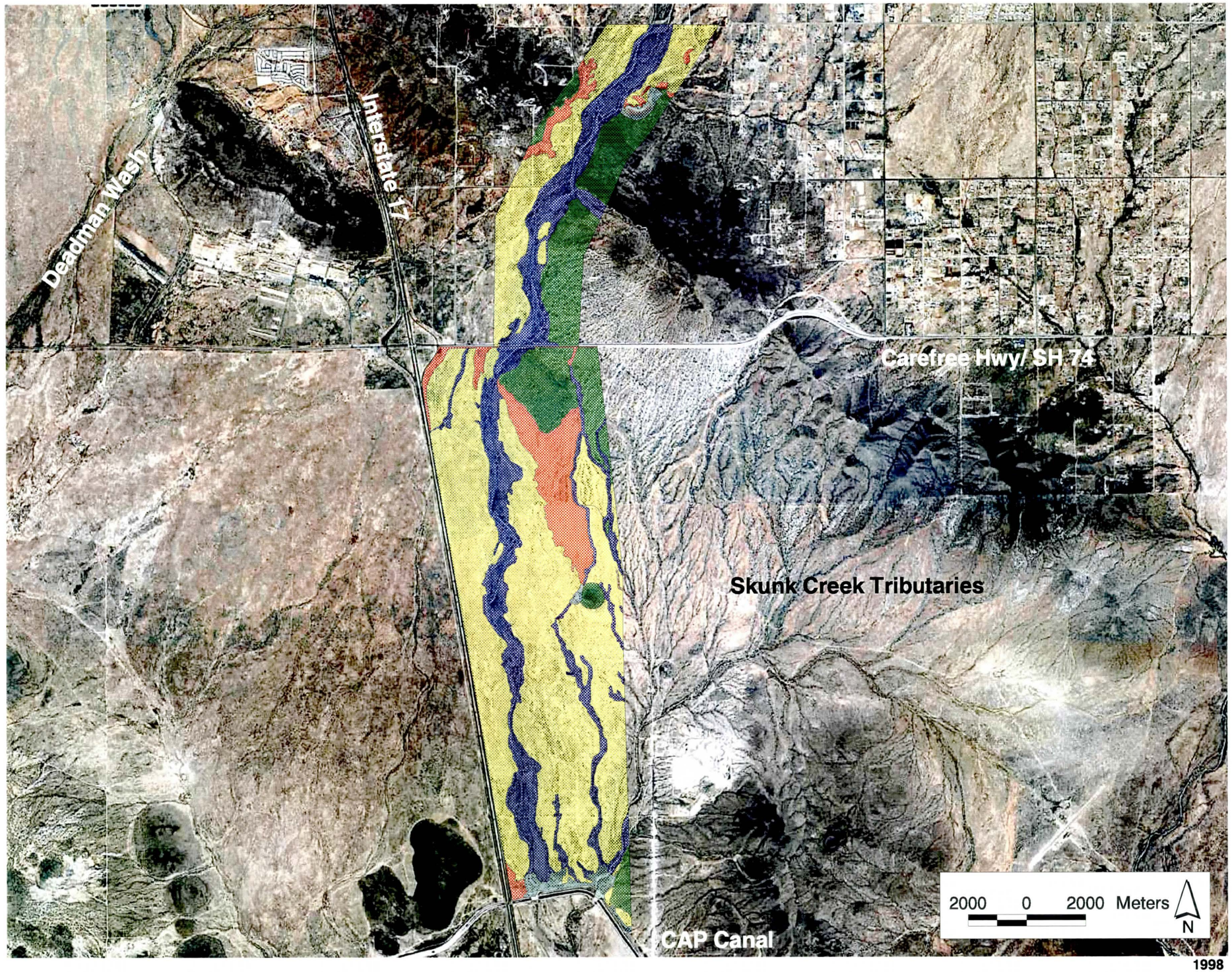
Skunk Creek Wash

Percent cover by species

Scientific Name	Common Name	Species	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	2.6	0	0	5.6	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	1.7	*	0	2.1	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	5.9	4.1	26.7	4.9	2.3
Baccharis sarothroides	Desert broom	BASA	0.4	0	0	0.1	0
Bebbia juncea	Sweetbush	BEJU	0.2	0	0	0	0
Carnegiea gigantea	Saguaro	CAGI	*	*	0	0	0
Cercidium floridum	Blue palo verde	CEFL	1.4	0	0	0	0
Cercidium microphyllum	Foothill palo verde	CEMI	3.6	0.7	7.6	0	0
Celtis pallida	Desert hackberry	CEPA	0.2	0	0	0	0
Echincereus engelmannii	Hedgehog cactus	ECEN	*	*	0.1	0	0
Encelia farinosa	Brittlebush	ENFA	*	*	4.2	0	0
Ephedra trifurca	Mormon tea	EPTR	0	0	0.1	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	0	*	*	0	0
Hymenoclea salsola	Burro bush	HYSA	2.0	0	0	1.8	0
Larrea tridentata	Creosote	LATR	11.7	9.2	8.1	23.3	1.4
Lycium sp.	Wolfberry	LYCI	3.1	0.6	1.2	0	0.5
Olneya tesota	Ironwood	OLTE	0	0.8	0.1	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	0.5	1.8	2.2	0.1	1.0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	0.1	0.4	*	0	1.2
Opuntia phaeacantha	Prickly pear cactus	OPPH	0	0	0.4	0	0
Prosopis velutina	Velvet mesquite	PRVE	7.2	3.4	1.0	0	1.8
Ziziphus obtusifolia	Graythorn	ZIOB	0.1	0	0	0	0

* present at less than .1%

**Apache Wash and the lower reach of Skunk Creek Wash were sampled in a dry year; while the remaining areas were sampled during the El Niño wet year. This accounts for the differ ences in percent herbaceous cover.



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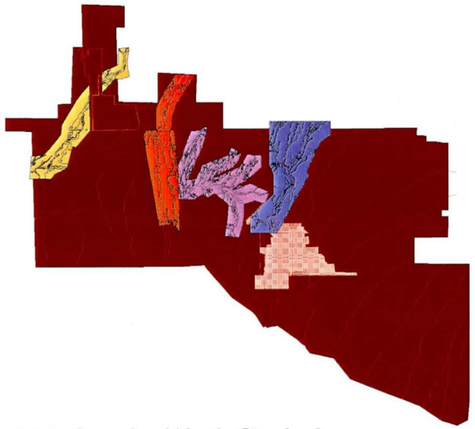
Skunk Creek Wash

Vegetation Types
- Wash
- Creosote Bush-Bursage Flats
- Hillsides and Slopes
- Tanks
- Damaged

- Federal Lands
- AZ Game & Fish
- Wash Centerlines

Location Map



- Apache Wash Study Area
- Deadman Wash Study Area
- Skunk Creek Wash Study Area
- Skunk Creek Tributaries Study Area

- Federal Lands
- AZ Game & Fish
- Cave Buttes Recreation Area
- Wash Centerlines
- North Phoenix

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Deadman Wash Study Area

Deadman Wash

Plant count by species (percent)

Scientific Name	Common Name	Code	All	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	1.4	3.0	0	0.2	0	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	6.0	12.1	0	0	21.6	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	56.2	46.3	66.1	68.2	2.7	63.6
Baccharis sarothroides	Desert broom	BASA	0.8	1.6	0	0	0	0
Bebbia juncea	Sweetbush	BEJU	*	0	0.2	0	0	0
Carnegiea gigantea	Saguaro	CAGI	0.1	0.1	0	0.2	0	0
Cercidium floridum	Blue palo verde	CEFL	0.8	1.4	0.2	0	2.7	0
Cercidium microphyllum	Foothill palo verde	CEMI	1.2	1.5	0.5	1.3	2.7	0
Celtis pallida	Desert hackberry	CEPA	2.3	4.2	0.0	0	21.6	0
Echincereus engelmannii	Hedgehog cactus	ECEN	0.4	0.2	0.8	0.2	0	0
Encelia farinosa	Brittlebush	ENFA	1.3	0.2	0.2	5.0	0	2.3
Ephedra trifurca	Mormon tea	EPTR	0.4	0.2	0	1.5	0	0
Erucameria laricifolia	Turpentine bush	ERLA	3.5	7.4	0	0	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	1.1	0.7	2.1	1.0	0	0
Hymenoclea salsola	Burro bush	HYSA	*	0.1	0	0	0	0
Krameria grayi	White ratany	KRGR	0.8	0	2.6	0.2	0	0
Larrea tridentata	Creosote	LATR	12.9	8.2	18.2	15.5	5.4	25.0
Lycium sp.	Wolfberry	LYCI	2.5	4.4	0	1.0	10.8	0
Mamillaria microcarpa	Fishhook pincushion	MAMI	0.1	0.1	0	0.2	0	0
Olneya tesota	Ironwood	OLTE	0.2	0.5	0	0	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	3.8	3.0	5.8	3.6	0	0
Opuntia bigelovii	Teddy bear cholla	OPBI	0.9	0	2.3	1.5	0	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	0.8	1.2	0.6	0.2	0	0
Opuntia phaeacantha	Prickly pear cactus	OPPH	0.1	0.2	0	0	0	0
Prosopis velutina	Velvet mesquite	PRVE	2.4	3.2	0.6	0.2	32.4	9.1
Ziziphus obtusifolia	Graythorn	ZIOB	0.1	0.2	0	0	0	0

* present at less than 0.1%

Deadman Wash

(83 Quadrats Total)

	Wash	Cbb	Hill	Tank	Damaged
No. Quads	39	24	11	4	5
Spp/quad	4.9	2.8	4.7	3.25	1.2
Percent cover by plant type					
Trees	41.6	0.9	10.5	84.5	0.1
Shrubs	27.0	20.6	34.8	10.8	2.0
Cacti	1.7	3.0	1.9	0	0

Deadman Wash

Percent herbaceous cover**

	Wash	Cbb	Hill	Tank	Damaged
0-5%	18	6	0	0	0
5-15%	18	3	0	0	0
15-25%	8	6	0	0	0
25-50%	3	15	40	0	100
50-75%	25	35	20	20	0
75-90%	23	18	0	60	0
90-100%	8	12	40	0	0

Deadman Wash

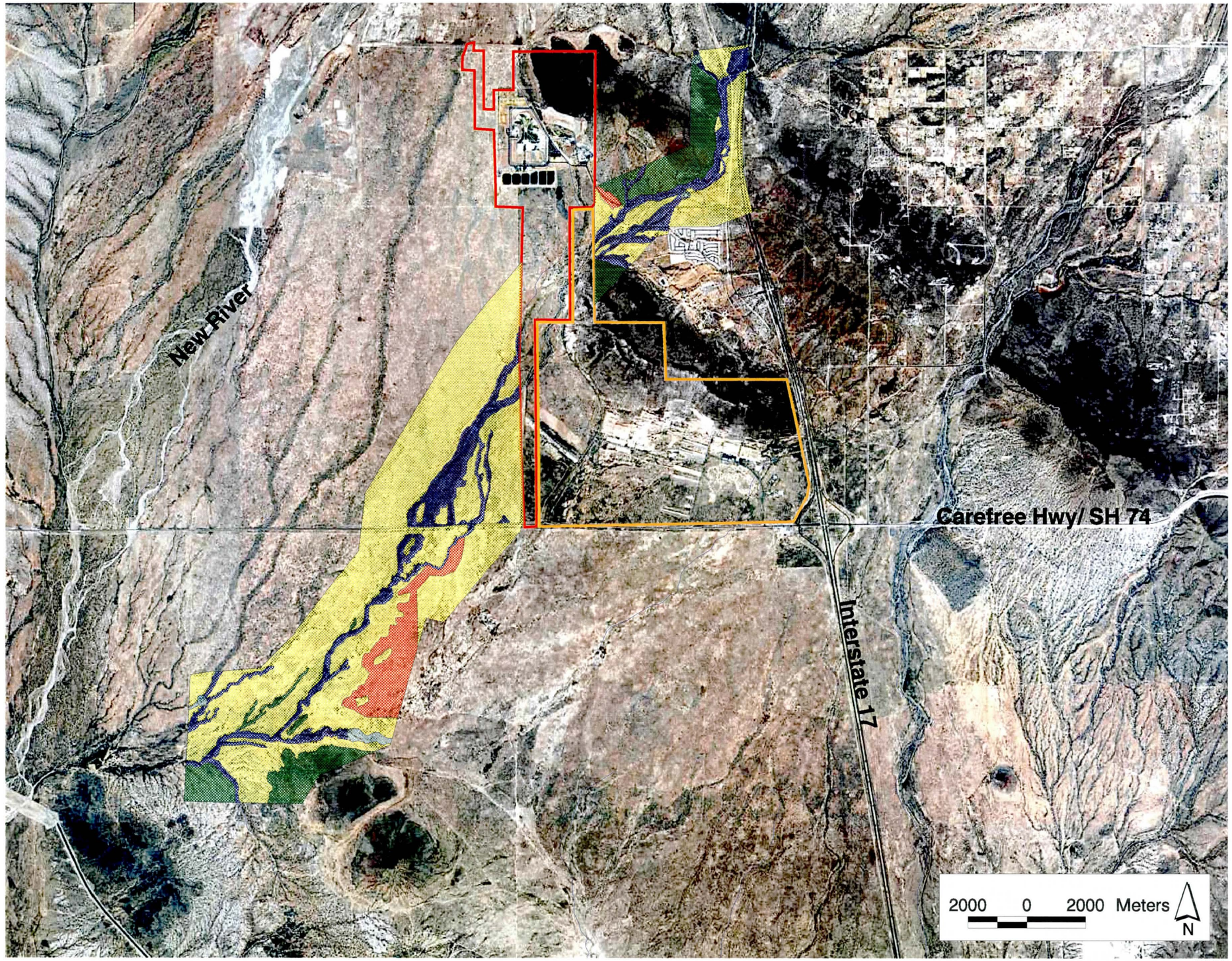
Percent Cover by Species

Scientific Name	Common Name	Code	All	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	3.2	3.2	0	0.4	0	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	1.9	3.9	0	0	2.7	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	6.0	5.7	7.0	9.3	0.1	1.2
Baccharis sarothroides	Desert broom	BASA	0.4	0.8	0	0	0	0
Bebbia juncea	sweetbush	BEJU	*	0	*	0	0	0
Carnegiea gigantea	Saguaro	CAGI	0	0	0	0	0	0
Cercidium floridum	Blue palo verde	CEFL	1.6	3.0	0.2	0	3.5	0
Cercidium microphyllum	Foothill palo verde	CEMI	6.9	10.3	0.5	9.9	11.8	0
Celtis pallida	Desert hackberry	CEPA	3.5	6.0	0	0	13.6	0
Echincereus engelmannii	Hedgehog cactus	ECEN	0	0	0	*	0	0
Encelia farinosa	Brittlebush	ENFA	0.2	0	0.1	1.2	0	0
Ephedra trifurca	Mormon tea	EPTR	0.1	0	0	0.8	0	0
Erucameria laricifolia	Turpentine bush	ERLA	0.5	1.0	0	0	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	0	0	0.1	0.1	0	0
Hymenoclea salsola	Burro bush	HYSA	*	*	0	0	0	0
Krameria grayi	White ratany	KRGR	0.1	0	0.2	0	0	0
Larrea tridentata	Creosote	LATR	12.9	12.9	13.3	21.0	3.5	0.8
Lycium sp.	Wolfberry	LYCI	1.7	2.5	0	2.2	4.5	0
Mamillaria microcarpa	Fishhook pincushion	MAMI	*	*	0	*	0	0
Olneya tesota	Ironwood	OLTE	1.9	4.0	0	0	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	1.6	1.3	2.6	1.4	0	0
Opuntia bigelovii	Teddy bear cholla	OPBI	0.1	0	0.1	0.3	0	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	0.1	0.2	0.1	0	0	0
Opuntia phaeacantha	Prickly pear cactus	OPPH	0.1	0.1	0	0	0	0
Prosopis velutina	Velvet mesquite	PRVE	8.3	11.7	0.2	0.2	55.5	0
Ziziphus obtusifolia	Graythorn	ZIOB	0.1	0.2	0	0	0	0

* present at less than 0.1%

**Apache Wash and the lower reach of Skunk Creek Wash were sampled in a dry year; while the remaining areas were sampled during the El Niño wet year. This accounts for the differences in percent herbaceous cover.

Deadman Wash



1998

Vegetation Types
- Wash
- Creosote Bush-Bursage Flats
- Hillsides and Slopes
- Tanks
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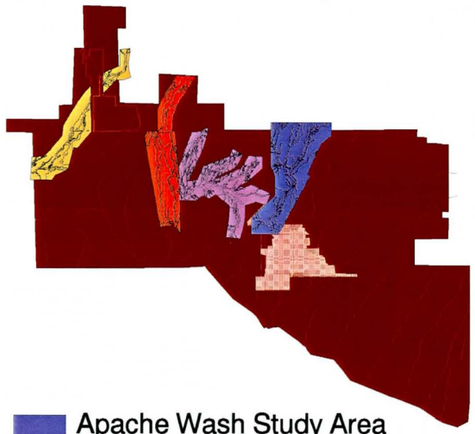
- Federal Lands
- AZ Game & Fish
- Wash Centerlines

Location Map



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- Federal Lands
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- North Phoenix

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Recommendations and Conclusion

The recommendations are subdivided into three categories: those adapted from the Cave Creek Wash study that are relevant to the preservation of the wash systems presented in this report, those impacting wildlife habitat, and those addressing further research needs.

Wash Preservation Recommendations

The recommendations listed below are adapted from those developed in the Cave Creek Wash study. They are noted here because they were considered by the working meeting participants and because they are relevant to the preservation of the washes under investigation in this study. The general principles used in making these recommendations adhere to concepts for preserve design advocated within the theory of island biogeography (Shafer 1990). Island biogeography theory was developed to predict the number of species found on real islands (MacArthur and Wilson 1967). It can be used as a starting point when planning preserves. The first four recommendations in the following list reflect general principles of preserve design, while the remainder respond to concerns and conditions more specific to the study areas. Each recommendation includes discussion and some examples.

1. Preserve as large an area as possible

It is generally agreed upon by ecologists that with all else being equal, a larger preserve can sustain a larger wildlife population (Shafer 1990). This is particularly true for large mammals since they require large home ranges, so preserving sufficient area is necessary for their survival. There are several factors that lead to an increase in species with an increase in area. First, larger areas usually contain a larger range of habitat types, and habitat diversity maintains species diversity. Second, larger habitat areas will contain more individuals of each species. The larger the population, the lower the probability that the species will disappear in the area. The smaller a population the more likely it is that the entire population will die out as a result of some chance fluctuation of a natural mortality factor such as predation, inclement weather, disease, or food shortage. If development proceeds before large areas of Sonoran Desert have been set aside for preservation, the area of natural habitat will become fragmented and isolated from other patches of natural habitat. The number of species would then gradually decline as the reduced open space would no longer be able to maintain existing populations that currently occupy the undeveloped larger region. Two of the most important variables affecting species diversity and population are the size of the preserve and its distance from other natural areas (MacArthur and Wilson 1967).

2. Minimize isolation and fragmentation of habitats

Isolated natural habitats, such as preserves, can be considered islands surrounded by oceans of areas unsuitable for native species. However, if other natural areas are close to the preserve, then populations that disappear locally can be reestablished by recolonization from these areas. The greater the isolation of a habitat island from other areas of natural habitat, the fewer species it will sustain. Therefore, to maintain species diversity every effort should be made to prevent isolation.

Landscape fragmentation should also be kept to a minimum. Even narrow barriers such as roads or gaps in habitat can prevent dispersal. For example, large mammals such as mule deer (Rost and Bailey 1979) and foxes (Storm et al. 1979) avoid roads. The best strategy for conserving the biological diversity of the wash systems is to preserve an unbroken corridor along each wash since they provide dispersal corridors for many organisms. The washes can also be used to connect other natural areas in order to reduce fragmentation at the larger scale.

3. Minimize contact with adjacent developed areas

The biological diversity of parks and ecological preserves declines as adjacent natural habitat becomes developed. This is part of what is often called the "edge effect." In order to minimize this effect, Diamond (1975) recommends round preserves with a minimum perimeter to area ratio.[6] In preserves with minimal edge length more of the preserve is remote from points of outside contact. Large areas of contact with human disturbance can produce many negative effects (Cox 1993; Primack 1993), such as increased contact with exotic plants or domesticated animals. It can also cause species that do well on edges and with human disturbance to thrive until they have negative effects on other native species (Stolzenburg 1991).

Edges can also encourage human activities such as poaching, harassment of wildlife, and refuse dumping on preserve lands. Many animals, such as nesting raptors,[7] are intolerant of extensive human contact. Highly irregular boundaries can lead to isolation and fragmentation since species may have to follow long circuitous routes to find patches of suitable habitat. Smooth boundaries with some areas relatively distant from an edge will allow a greater range of species to persist within the preserve.

4. Preserve as much wash vegetation as possible

This vegetation provides a system of corridors for the dispersal of wildlife and connections to hillsides and other open space. Corridors are efficient means for reducing isolation of natural areas. They provide higher immigration rates between populations, help maintain habitat diversity, offer dispersal routes for animals with large home ranges, and act as safe refuges (Noss 1987; Shafer 1990). Corridors may provide a "rescue effect" where species that die out locally are reestablished by colonists dispersing through a corridor (Brown and Kodric-Brown 1977; Simberloff 1980). They can also serve as greenbelts that help to mitigate urban sprawl by providing recreation areas, scenic value, and pollution abatement (Noss 1987).

5. Preserve beyond the 100-year flood zone

Were the 100-year flood zone the only land to be preserved, not all vegetation types would be included. The 100-year flood zone, as shown on Federal Emergency Management Agency (FEMA) maps, would capture all of wash and most of the tank vegetation, some of the creosote bush-bursage vegetation, but no hillside vegetation. The creosote bush-bursage flats are important hunting ground for mammals and birds. The hillside vegetation contains the majority of saguaro, which are used by birds for nesting and perching and provide a rich seed source for many animals. Plant and animal diversity would be maximized if each vegetation type were preserved. Other considerations that support the preservation of more than the FEMA 100-year flood zone are the tendency of desert washes to migrate and the lack of FEMA information for the Skunk Creek Wash tributaries.

6. Prohibit grazing within the preserve

Evidence of changes in vegetation composition due to grazing and examination of soil maps suggest further differentiation of vegetation types may be present if grazing is discontinued. Selective feeding habits of cattle favor some plant species over others, which can disrupt the natural vegetation composition (figure 17).

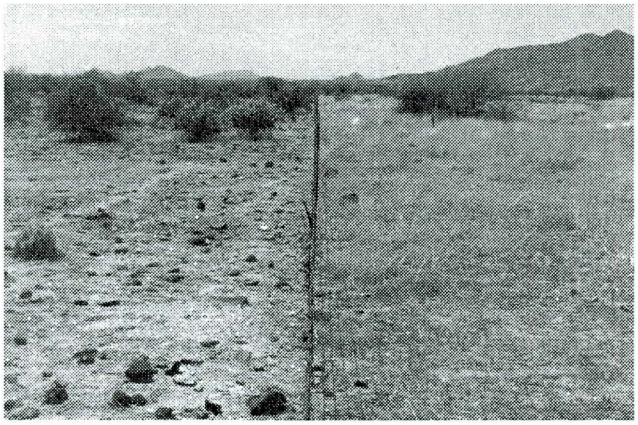

Figure 17–Grazing effects on vegetation

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6 i.e., minimize the ratio of perimeter (p) to area (a) for the boundary: p/a=minimum.

7 birds of prey

7. Maintain the integrity of the watershed
Changes in drainage patterns and increased peak flows due to changes in land use can cause accelerated soil erosion, higher scouring, stream bank undercutting, and higher potential of flooding downstream (Dunne and Leopold 1978). The more of the watershed for the wash systems included in the preserve, the less disruption to the wash system will occur. Water quality should be considered, and efforts should be made to maintain water quality within the preserve.

Wildlife Habitat Recommendations

1. Maintain a diversity of animal habitats and species
Many different criteria can be used to prioritize areas for preservation (Spellerberg 1992), but all ranking systems emphasize maintaining habitat and species diversity. In general, preserving a diversity of plant communities will preserve a diversity of animal species, and diversity of animal habitats and species will be maximized if plant diversity is maximized (Diamond 1986). Different species require different habitats, so increasing the number of habitats increases the number of species that can live in the area. Some animals require several different landscape and vegetation types to survive. Where animals hunt or forage for food can be quite different from where they find shelter to raise their young. Thus, plant species diversity should be maintained.

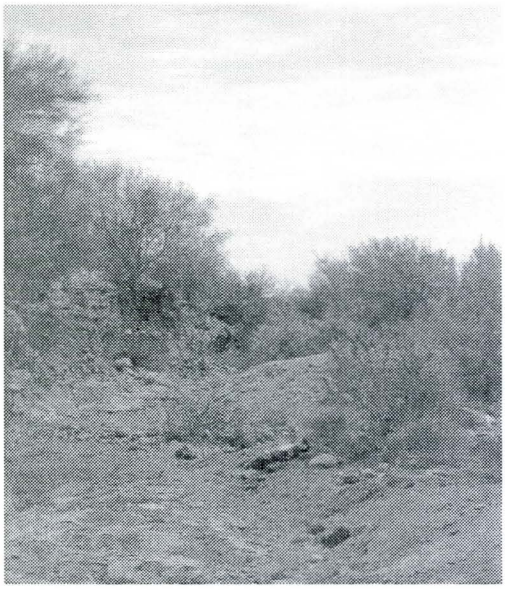

Figure 18–Cliffs along Skunk Creek Wash

2. Maintain the cliff areas along Skunk Creek Wash
The cliffs provide habitat for cavity nesting animals, so they should remain undisturbed by development or resource extraction. The cliffs are formed by a series of ledges of caliche material. This material erodes and provides many cracks, holes, and shelves that are excellent habitat for reptiles and mammals such as the western banded gecko, great-horned owls, rock squirrels, coyote, and rattlesnakes. It is likely that bats and cliff swallows utilize crevices in the cliffs (figure 18).

3. Maintain tanks and surrounding vegetation
Although the tanks are a cultural artifact and not purely natural, they function as semiperennial wetlands. Great blue heron have been observed at a tank along Deadman Wash. The tanks maintain thick bosques of mesquite and stands of blue palo verde that provide bird nesting sites and shade. They could also be used as interpretive elements for teaching about previous land uses, in particular cattle grazing. The stock tanks are an important water source and support amphibious species. For example, three species of amphibians-—the red-spotted toad, Colorado river toad, and southwestern toad—have been associated with the tanks[8] (figure 19).

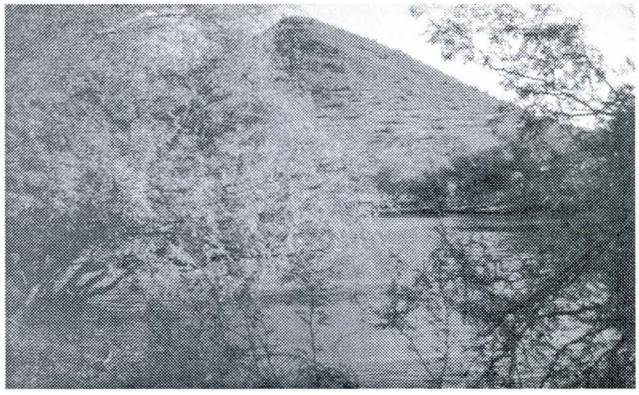

Figure 19–Tin Can Tank

[8] Amphibians were observed in the Skunk Creek Wash study area during the wildlife inventory being conducted by Dr. William Miller.

4. Preserve areas representing mosaics of the four undamaged vegetation classifications[9]

Many animals require different habitat types and preserving these nearby to one another will help maintain these species. An animal will frequently use different types for eating, resting, and reproduction. Maintaining mosaics of different vegetation types can ensure that more species will have their needs met. However, predicting which species will decline if different habitat combinations are not maintained would require a detailed analysis of each species. Detailed wildlife analysis was beyond the scope of this study, but preserving mosaics of vegetation types would decrease the probability of disturbing animal species diversity.

The wash edges, hillsides, and sloped terrain contain the best habitat for many vertebrates. The diversity of trees, shrubs, and the presence of saguaros within these classifications provides nesting sites for birds and cover for mammals. Animals such as Gambel's quail and coyote are commonly found along the washes. Ironwoods are important trees for wildlife, and numerous mature specimens are found along small drainageways and slopes. Saguaros provide habitat for a large community of animals. A variety of cavity-nesting birds, such as Gila woodpeckers and elf owls, use saguaros. These vegetation types are also extremely important for producing seeds that are utilized by rodents, birds, javelina, and many other animals. The wash bottom is also an important travel corridor for large mammals; desert mule deer were observed along Skunk Creek Wash.[10]

Some animal species have specialized habitat requirements. The following examples illustrate how animals use the four undisturbed vegetation types to satisfy their distinct habitat needs. Preserving mosaics of the four vegetation types would help these and other species survive.

Mammals

- Coyote are opportunistic and very adaptable, feeding on saguaro fruit, mesquite beans, rabbit, rodents, small reptiles, insects, and carrion (Cochran 1989). They would range in all vegetation types. However, road crossings could be hazardous to coyotes and other mammals using the wash as a travel corridor.
- Bobcat diet mostly on pack rat and quail—animals whose habitats include the hillsides, washes, and the creosote-bursage flats. Bobcat dens are often located in a hole in a hillside (Cochran 1989).
- Desert mule deer are generally browsers of woody shrubs and trees but also graze. They have been seen along Skunk Creek Wash.
- Black-tailed jackrabbits prefer the scrubby desert grasslands found within the creosote bush-bursage flats.
- White-throated wood rat, also known as the pack rat, prefers the bajadas[11] and builds its nest in association with cholla and under trees.

Reptiles and Amphibians

- Western diamondback rattlesnake prefers rocky terrain, common to the hillsides, as refuge and feeds on rodents and rabbits who frequent the creosote bush-bursage flats.
- Greater earless lizard prefers washes where loose sand and gravel provide quick refuge from predators.

Birds

Birds play important roles in ecological communities and increase people's interest in natural areas. Many birds typical to the Sonoran Desert require a mosaic of habitats. Birds require specific sites for nesting and will often use large areas in different vegetation types to forage for food.

- Cactus wrens frequently nest in cholla found along the hillsides, sloped terrain, and creosote bush-bursage vegetation.
- Elf owls nest in saguaros found on the margins of small washes and on slopes.
- White-wing doves require densely branched trees 20 to 40 feet high. Their preferred nesting sites are in palo verdes and ironwoods (Brown 1989). The highest concentrations of such trees are along wash edges. They forage widely for food in other habitats, eating such foods as saguaro fruits, ocotillo seeds, and jojoba nuts.
- Great-horned owls hunt rabbits and rodents primarily but will also prey on birds (MacMahon 1988). Their prey tends to inhabit the creosote bush-bursage flats.

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9 A landscape or vegetation mosaic is the composition and spatial organization of components (Forman 1995); in this case the mosaics refer to compositions of the four vegetation types. Damaged areas are not considered.

10 The mule deer were observed during the wildlife inventory being conducted by Dr. William Miller.

11 A bajada is the apron of alluvial deposits formed where a series of mountain streams or washes emerge onto a plain.

- Red-tailed hawks soar over the open areas of the creosote bush-bursage flats. This is typical of their hunting behavior as they feed primarily on small rodents and rabbits that inhabit this vegetation community (Udvardy and Farrand 1994).
- A covey of Gambel's quail uses 19 to 95 acres. They roost in large trees at night. During the day they move along arroyos to reach foraging sites in the more open desert. Quail depend largely on seeds of winter annuals that are abundant in the creosote bush-bursage flats (Brown 1989). They seek cover in shady areas found along washes during the heat of the day.

Further Research Recommendations and Conclusion

During the working meetings, there was considerable discussion on the effects and character of future adjacent development and increased human activity. Knowing the existing ecological integrity of the preserve was identified as essential for ensuring continued health and maintenance of the desert flora and fauna. The consensus among ecologists is that the bigger the area preserved, the better; this belief was echoed during the meetings. In reviewing the approved preserve boundary, there were no direct criticisms. Rather, it was recommended that the preserve be further studied as an ecological system. The prioritized list below identifies research needed to this end and includes other studies that address human impacts.

1. Continue the vegetation and wildlife inventories to include the remaining land within the preserve. For vegetation, the hills need to be mapped. For wildlife, Apache Wash, Deadman Wash, and the Skunk Creek Wash tributaries that are within the preserve and all the hills need to be inventoried.
2. Examine fluvial dynamics of each wash. The Maricopa County Flood Control District has begun to study the Cave Creek and Apache washes and to consider nonstructural flood control methods and lateral migration of the stream beds. Similar studies should be conducted for the other washes within the preserve.
3. Set up long-term monitoring sites to examine edge effect, changes in species composition, and diversity within the proposed preserve that result from influences at the preserve edge. This would facilitate the monitoring and managing of the ecological integrity of the preserve and allow for analyzing changes in vegetation and wildlife over time.
4. Conduct soil surveys to inform long-term land management decisions.
5. Examine the process for developing the preserve boundary to continue to build layers of research and data that supports and improves this method of taking an ecological approach to preserve design. Issues of connectivity and ecological integrity need to be considered.
   A review of existing studies and preserves should be included in this study.
6. Conduct case studies of other existing preserve lands to consider road crossings with regard to number, widths, and character (e. g., parkway, freeway, commercial strip).
   A review of existing studies that examine effects of road crossings should be included.
7. Conduct comparative studies for analyzing wash buffer widths.
8. Study wildlife movement to help inform corridor planning with regard to corridor widths and orientation.
9. Examine management plans for urban wild land preserves to help the PRLD as they develop the management plan for the Sonoran Preserve.

As an extension of the Cave Creek Wash study, this report enlarged the range of vegetation analysis more than four-fold. The results can be used in further preservation planning in the North Phoenix area. Integrating this kind of ecological information into land-use planning will help the PRLD carry on and improve upon their legacy of preserve development. For over thirty years, the only large land parcels set aside for preservation in the City of Phoenix are the result of the PRLD's proactive leadership and guidance. It is hoped that this study and others like it contribute to developing park lands that preserve the ecological integrity and health of the Sonoran Desert that has become emblematic of Phoenix's quality of life.

Appendix A—Flora and Fauna Species Lists

COMPREHENSIVE VEGETATION LIST

(Alphabetized by scientific name)

Trees

Acacia greggii	Catclaw acacia
Celtis pallida	Desert hackberry
Cercidium floridum	Blue palo verde
Cercidium microphyllum	Foothill palo verde
	Little leaf palo verde
Olneya tesota	Ironwood
Prosopis velutina	Mesquite

Shrubs

Ambrosia ambrosioides	Bursage
Ambrosia artemisifolia	Common rag weed
Ambrosia deltoidea	Triangle-leaf bursage
Ambrosia eriocentra	Wooly bursage
Baccharis salicifolia	Seep willow
Baccharis sarothroides	Desert broom
Bebbia juncea	Sweet bush
Calliandra eriophylla	Fairy duster
Cassia artemisioides	Feathery or Silvery cassia
Chrysothamnus sp.	Rabbit brush
Encelia farinosa	Brittlebush
Ephedra trifuca	Mormon tea
Gutierrezia sarothrae	Snakeweed
Hymenoclea salsola	Burro brush
Krameri agrayi	White ratany
Larrea tridentata	Creosote bush
Lycium andersonii	Anderson thornbush
Lycium fremontii	Fremont thornbush
Ziziphus obtusifolia	Graythorn

Cacti

Carnegiea gigantea	Saguaro
Echincereus engelmannii	Hedgehog cactus
Ferocactus acanthodes	Barrel cactus
Mammilaria microcarpa	fish hook cactus
	pin cushion cactus
Opuntia acanthocarpa	Buckthorn cholla
Opuntia arbuscula	Pencil cholla
Opuntia bigelovii	Teddy bear cholla
Opuntia fulgida	Chain fruit cholla
	Jumping cholla
Opuntia imbricata	Tree cholla
Opuntia leptocaulis	Desert Christmas cactus
Opuntia phaeacantha	Prickly pear cactus

Forbs

Acourtia wrightii	Brownfoot
Amaranthus blitoides	Prostrate pigweed
Amsinckia intermedia	Fiddleneck
Astragalus nutallianus	Nutall locoweed
Boerhaavia diffusa	Spiderling
Bowlesia incana	Hairy boweslia
Brickellia coulteri	Brickell bush
Camissonia californica	Mustard evening primrose
Capsella bursa-pastoris	Shepherdspurse
Cassia covesii	Desert senna
Centaurea solstitialis	Yellow starthistle
Chaenactis stevioides	Esteve's pincushion
Chenopodium sp.	Lambsquarter
Chorizanthe brevicornu	Brittle spine flower
Chorizanthe rigida	Rigid spiny herb
Clematis drummondii	Virgin's bower
Daucus pusillus	Wild carrot
Descurainia pinnata	Yellow tansy mustard
Dichelostemma pullchellum	Blue dick
Erigeron divergens	Spreading fleabane
Eriogon umdeflexum	Buckwheat, Skeleton weed
Eriogonum inflatum	Desert trumpet
Eriophyllum lanosum	Wooly daisy
Erodium cicutarium	Filaree
Erodium texanum	Texas filaree
Eschscholtzia californica	Mexican poppy
Eucrypta micrantha	Small-flowered eucrypta
Euphorbia albomarginata	Rattlesnake weed
Euphorbia sp.	Spurge
Funastriium hirtellum	Rambling milkweed
Galium stellatum	bedstraw
Herniaria cinerea	Burstwort
Janusia gracilis	Slender janusia
Lactuca serriola	Prickly lettuce
Lashtenia chrysostoma	Goldfields
Lesquerella gordonii	Gordon's bladderpod
Linanthus demissus	White starflower lianthus
Lotus humistratus	Hill lotus
Lotus tomentellus	Hairy lotus
Lupinus concinnus	Lupine
Malva neglecta	Common mallow

Malva parviflora	Mallow
Medicago polycarpa	Burclover
Melilotus officinalis	Yellow sweetclover
Melilotus sp.	Clover
Microseris linearifolia	Silver puffs
Monolepis nutalliawa	Poverty weed
Oenothera primiveris	Evening primrose
Orthocarpus purpurascens	Owl clover
Pectocarya recurvata	Arch-nutted comb
Phacelia distans	Wild heliotrope
Porophyllum gracile	Odora
Polygonum aviculare	Prostrate knotweed
Pterostegia drymarioides	ncn
Rafinesquia neomexicana	Desert chicory
Salsola iberica	Russian thistle
	Tumble weed
Salvia columbariae	Chia
Silene antirrhina	Sleepy catchfly
Sisymbrium altissimun	Tumble mustard
Sisymbrium irio	Yellow rocket
Sphaeralcea ambigua	Desert globe mallow
Sonchrus oleraceus	Annual sowthistle
Trixis californica	Trixis

Grasses

Aristida purpurea	Purple threeawn
Avena barbata	Oats
Bromus catharticus	Rescue grass
Bromus rubens	Redbrome
Cynodon dactylon	Bermuda grass
Erioneuron pulchellum	Fluff grass
Hilaria mutica	Tobosa
Hordeum arizonicum	Arizona barley
Lepidium densiflorum	Pepperweed
Phalaris caroliniana	Carolina canary grass
Poa bigelovii	Bigelow bluegrass
Vulpia octoflora	Six weeks fescue
Schismus barbatus	Mediterranean grass

WILDLIFE[12]

Mammals

Black-tailed jackrabbit
Bailey's pocket mouse
Cactus mouse
Coyote
Desert cottontail
Desert mule deer
Merriam's kangaroo rat
Rock squirrel
White-throated woodrat

Birds

White-crowned sparrow
Bobcat
Cactus wren
Common raven
Gambel's quail
Great blue heron
Great-horned owl
House finch
Mourning dove
Northern mockingbird
Phainopepla
Red-shafted flicker
Red-tailed hawk
Rock dove
Turkey vulture
White-crowned sparrow
White-winged dove

Reptiles and Amphibians

Colorado river toad
Common kingsnake
Common tree lizard
Greater earless lizard
Mojave rattlesnake
Red-spotted toad
Sonoran gopher snake
Southwestern toad
Western diamondback
Western whiptail lizard
Zebra-tailed lizard

[12] Observed in the field or from the preliminary list from Dr. Miller's wildlife study.

Apache Wash

Plant counts by species (raw)

Scientific Name	Common Name	Code	All	Wash	Cbb	Hill	Tank
Acacia greggii	Cat-claw acacia	ACGR	74	72	1	0	1
Ambrosia ambrosioides	Big-leaf bursage	AMAM	147	147	0	0	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	1303	245	709	349	0
Baccharis sarothroides	Desert broom	BASA	11	11	0	0	0
Cassia covesii	Desert senna	CACO	4	0	4	0	0
Carnegiea gigantea	Saguaro	CAGI	5	1	1	3	0
Cercidium floridum	Blue palo verde	CEFL	14	10	1	0	3
Cercidium microphyllum	Foothill palo verde	CEMI	17	10	5	0	2
Celtis pallida	Desert hackberry	CEPA	4	3	1	0	0
Clematis drummondii	Virgin's bower	CLDR	7	7	0	0	0
Echincereus engelmannii	Hedgehog cactus	ECEN	9	1	3	5	0
Ferocactus acanthodes	Barrel cactus	FEAC	14	1	8	5	0
Fouquieria splendens	Ocotillo	FOSP	1	0	1	0	0
Krameria grayii	White ratany	KRGR	18	0	7	11	0
Larrea tridentata	Creosote	LATR	406	131	224	47	4
Lycium sp.	Wolfberry	LYCI	74	46	18	10	0
Olneya tesota	Ironwood	OLTE	5	4	0	1	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	86	10	58	18	0
Opuntia arbuscula	Pencil cholla	OPAR	6	2	3	0	1
Opuntia bigelovii	Teddy bear cholla	OPBI	34	1	3	30	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	34	3	29	2	0
Opuntia phaeacantha	Prickly pear cactus	OPPH	4	2	0	2	0
Prosopis velutina	Velvet mesquite	PRVE	101	32	16	24	29
Ziziphus obtusifolia	Graythorn	ZIOB	33	22	11	0	0
TOTALS			**2411**	**761**	**1103**	**507**	**40**

Skunk Creek Tributaries

Plant counts by species (raw)

Scientific Name	Common Name	Code	All	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	26	22	1	0	3	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	60	60	0	0	0	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	1938	537	658	735	0	8
Baccharis sarothroides	Desert broom	BASA	2	2	0	0	0	0
Bebbia juncea	Sweetbush	BEJU	1	1	0	0	0	0
Carnegiea gigantea	Saguaro	CAGI	8	4	3	1	0	0
Cercidium floridum	Blue palo verde	CEFL	4	4	0	0	0	0
Cercidium microphyllum	Foothill palo verde	CEMI	41	38	0	1	2	0
Celtis pallida	Desert hackberry	CEPA	29	27	0	0	2	0
Echincereus engelmannii	Hedgehog cactus	ECEN	12	3	6	3	0	0
Ephedra trifurca	Mormon tea	EPTR	2	1	0	1	0	0
Encelia farinosa	Brittlebush	ENFA	131	67	6	58	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	19	2	3	14	0	0
Fouquieria splendens	Ocotillo	FOSP	3	0	1	2	0	0
Hymenoclea salsola	Burro bush	HYSA	2	2	0	0	0	0
Krameria grayi	White ratany	KRGR	130	55	20	54	1	0
Larrea tridentata	Creosote	LATR	284	119	111	50	1	3
Lycium sp.	Wolfberry	LYCI	44	43	1	0	0	0
Mamillaria microcarpa	Fishhook pincushion	MAMI	2	0	0	2	0	0
Olneya tesota	Ironwood	OLTE	7	7	0	0	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	127	34	50	43	0	0
Opuntia arbuscula	Pencil cholla	OPAR	1	1	0	0	0	0
Opuntia bigelovii	Teddy bear cholla	OPBI	105	0	92	13	0	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	16	11	4	1	0	0
Prosopis velutina	Velvet mesquite	PRVE	34	25	6	0	3	0
Simmondsia chinensis	Jojoba	SICH	2	2	0	0	0	0
TOTAL S			**3030**	**1067**	**962**	**978**	**12**	**11**

Skunk Creek Wash

Plant count by species (raw)

Scientific Name	Common Name	Species	All	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	24	16	1	0	7	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	95	70	3	0	22	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	1595	496	564	448	47	40
Baccharis sarothroides	Desert broom	BASA	11	5	0	0	6	0
Bebbia juncea	Sweetbush	BEJU	31	31	0	0	0	0
Carnegiea gigantea	Saguaro	CAGI	3	1	2	0	0	0
Cercidium floridum	Blue palo verde	CEFL	6	6	0	0	0	0
Cercidium microphyllum	Foothill palo verde	CEMI	31	24	1	6	0	0
Celtis pallida	Desert hackberry	CEPA	1	1	0	0	0	0
Echincereus engelmannii	Hedgehog cactus	ECEN	15	4	2	9	0	0
Encelia farinosa	Brittlebush	ENFA	45	1	3	41	0	0
Ephedra trifurca	Mormon tea	EPTR	2	0	0	2	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	3	0	1	2	0	0
Hymenoclea salsola	Burro bush	HYSA	133	129	0	0	4	0
Larrea tridentata	Creosote	LATR	309	155	106	31	12	5
Lycium sp.	Wolfberry	LYCI	42	34	3	4	0	1
Olneya tesota	Ironwood	OLTE	3	1	1	1	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	71	16	25	27	1	2
Opuntia leptocaulis	Desert Christmas cactus	OPLE	20	4	12	1	0	3
Opuntia phaeacantha	Prickly pear cactus	OPPH	1	0	0	1	0	0
Prosopis velutina	Velvet mesquite	PRVE	46	19	25	1	0	1
Ziziphus obtusifolia	Graythorn	ZIOB	10	10	0	0	0	0
TOTALS			**2497**	**1023**	**749**	**574**	**99**	**52**

Deadman Wash

Plant count by species (raw)

Scientific Name	Common Name	Code	All	Wash	Cbb	Hill	Tank	Damaged
Acacia greggii	Cat-claw acacia	ACGR	32	31	0	1	0	0
Ambrosia ambrosioides	Big-leaf bursage	AMAM	133	125	0	0	8	0
Ambrosia deltoidea	Triangle-leaf bursage	AMDE	1245	479	411	326	1	28
Baccharis sarothroides	Desert broom	BASA	17	17	0	0	0	0
Bebbia juncea	Sweetbush	BEJU	1	0	1	0	0	0
Carnegiea gigantea	Saguaro	CAGI	2	1	0	1	0	0
Cercidium floridum	Blue palo verde	CEFL	17	15	1	0	1	0
Cercidium microphyllum	Foothill palo verde	CEMI	26	16	3	6	1	0
Celtis pallida	Desert hackberry	CEPA	51	43	0	0	8	0
Echincereus engelmannii	Hedgehog cactus	ECEN	8	2	5	1	0	0
Encelia farinosa	Brittlebush	ENFA	28	2	1	24	0	1
Ephedra trifurca	Mormon tea	EPTR	9	2	0	7	0	0
Erucameria laricifolia	Turpentine bush	ERLA	77	77	0	0	0	0
Ferocactus acanthodes	Barrel cactus	FEAC	25	7	13	5	0	0
Hymenoclea salsola	Burro bush	HYSA	1	1	0	0	0	0
Krameria grayi	White ratany	KRGR	17	0	16	1	0	0
Larrea tridentata	Creosote	LATR	285	85	113	74	2	11
Lycium sp.	Wolfberry	LYCI	55	46	0	5	4	0
Mamillaria microcarpa	Fishhook pincushion	MAMI	2	1	0	1	0	0
Olneya tesota	Ironwood	OLTE	5	5	0	0	0	0
Opuntia acanthocarpa	Buckthorn cholla	OPAC	84	31	36	17	0	0
Opuntia bigelovii	Teddy bear cholla	OPBI	21	0	14	7	0	0
Opuntia leptocaulis	Desert Christmas cactus	OPLE	17	12	4	1	0	0
Opuntia phaeacantha	Prickly pear cactus	OPPH	2	2	0	0	0	0
Prosopis velutina	Velvet mesquite	PRVE	54	33	4	1	12	4
Ziziphus obtusifolia	Graythorn	ZIOB	2	2	0	0	0	0
TOTALS			**2216**	**1035**	**622**	**478**	**37**	**44**

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